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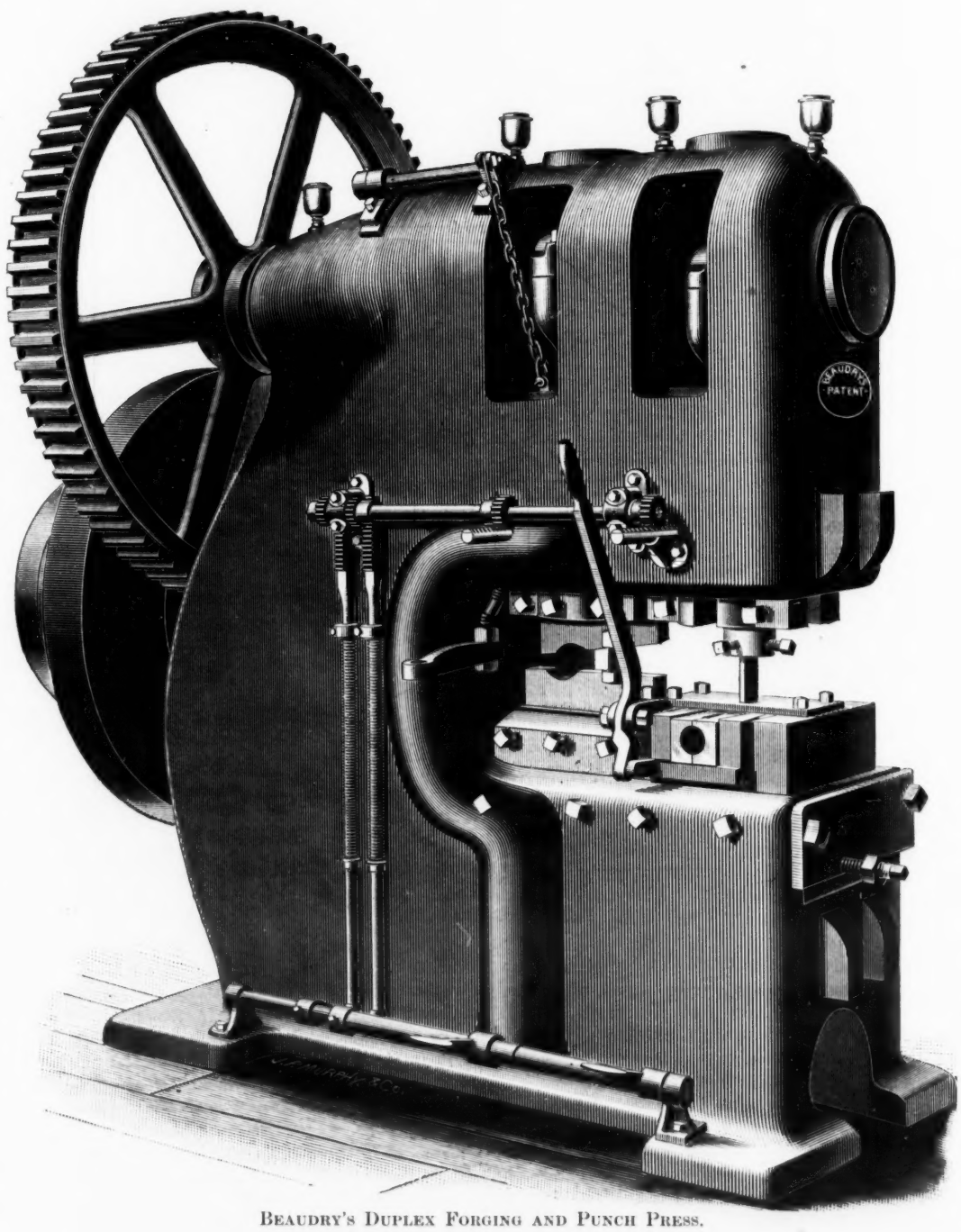
ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Beaudry's Duplex Forging and Punch Press.

With this we present an illustration of a newly designed forging, punching and shearing press. There are two plungers connected with the crank-shaft in such a manner that they may be worked independently, or may be run together, as may be preferred; and either one may be used as a shear, a punch, or as a forging press, while the other is in use for the same or any other purpose. Like the other presses made by the same firm, the connection is made between the plunger and the slide by introducing a wedge between the two, when it is desired to make the slide descend, the distance to which the wedge is introduced determining the point to which the slide shall descend; and as these wedges are controlled by the operator, by means of the treadles and connecting mechanism shown, the motion of the slides is under perfect control, and the punch or shear may be brought down exactly to a prick punch mark or scribed line, while at the same time both hands are free to handle the work. The shears can be put in either way, so that large plates can be cut. The machine is simple in construction, and therefore easily managed, as well as economical in the matter of power. It will be noticed, also, that the machine requires comparatively little floor space, for a machine of its range and capacity. As will be perceived, the machine is of heavy proportions, all the parts being intended to possess ample strength for the work they have to do. The crank-shaft is of hammered steel, with very large bearing surfaces. The presses are adapted to making all that class of forgings usually made in drop hammers, and it is possible to so arrange the different dies as to perform six or eight operations upon a piece successively at one heating. It is found that dies can be made of cast-iron for use in this machine, which, for a drop hammer, would need to be made of steel, because the forging in this machine is done by a steady pressure, instead of by a blow, with its accompanying shock and destructive action. They are built in several sizes, for use in machine, boiler, blacksmith, cutlery and jewelry shops, and in manufactories of stamped, pressed, and other hollow ware, for all of which purposes they are being very successfully used. The crank-shaft revolves continuously when the machine is in use; no clutch being used. The proportions of the one shown are: Stroke, 2½″ to 3¼″; throat space, 26″; pulley, 6¼″x30″; floor space, 7′x4′. The machine weighs 10 tons, and will punch a 2½″ hole through 1″ iron, and cut 3″ round, or 7″x1¼″ flat bars. The fly-wheel runs at 200 revolutions. The makers are Beaudry & Co., Boston, Mass.



BEAUDRY'S DUPLEX FORGING AND PUNCH PRESS.

The Friction of Slide Valves.

BY W. H. BOOTH.

Much has been written, and still is written, on the subject of slide valve friction. Some engineers will calculate the power necessary to move a slide valve by multiplying the area of the valve in square inches by the steam pressure, and by the coefficient of friction between the surfaces in contact. Such coefficients are usually taken from pocket-book tables, which profess to tell the amount of such coefficients of friction as existing between surfaces of various materials, dry, wet or lubricated; but there is very little doubt but that such coefficients are exceedingly misleading, and, if trusted in, would lead to curious results.

Slide valve friction is not of a nature to be judged from experiments on the sliding of metals, conducted as such experiments usually are—cold. Nor can the effect of steam pressure on the back of a valve be taken as so much load upon it. At times it may be so, but there are times when the effect of pressure is much reduced.

It is very common to assume that the existence of steam under a valve face is prima facie evidence of leakage, but there is no proof adducible that such an inference can be fairly or justly drawn, nor again can the usually drawn inference be supported that a *well*-lubricated valve will work more easily than one badly lubricated, where the words *well* and *badly* mean simply a state of lubrication such as would be reasonably inferred from the fact of a large or a very small quantity of lubricant being consumed. No engineer has ever seen the face of a slide valve when at work, and no one can therefore say in what condition the lubricant between the working faces may exist.

The life of a slide valve is very varied. In locomotives, a slide valve of good brass would be considered to have done well if it saw the engine through a mileage of 10,000. In stationary engines, slide valves last a lifetime. This difference may be due to the fact that hitherto stationary engines have worked at very low pressures as compared with locomotives, which, at the high temperature corresponding to a pressure of 120 or 140 pounds, are scarcely to be expected to possess long-lived slide valves.

At one time the writer was very considerably occupied amongst steam engines, and had opportunities of acquiring information, of a very practical nature, upon the working of slide valves. Amongst other matters of special interest were several instances of apparently abnormal slide valve behavior of a similar nature, and going to indicate, if not to absolutely prove, that over-lubrication of a slide valve may be almost, or quite, as bad as an insufficiency. It was noticed that the rapid filling into the valve chest direct, of a whole cupful of lubricant, caused the valve to work with a heavy grinding sound, and produced severe vibration of the eccentric rod. This gave rise to further thought and observation, and opportunities were taken of making other similar tests, and in several instances it was observed that an overflush of oil would produce similar bad effects, and heavy grinding motion of the valve. Thinking upon this, the explanation which seemed most likely to be correct was as follows:

Between the working faces of valve and cylinder there should not be metallic contact, and usually there will not be; but there will be a film of oil or water, or a mixture of the two, existing between the surfaces. Water existing between such surfaces must necessarily be of the same temperature as the surfaces between which it is, and will, therefore, be in a state of ebullition, or nearly so. Actually, it will give off steam at the pressure corresponding to the temperature, and as such steam will press equally in all directions, we may take it that the slide valve is really sliding upon an infinite number of water globules separated by layers of steam, and supported, against being flattened out, by the steam. If the valve were floating on a film of steam alone, it would be perfectly balanced, except for the area of ports cut away beneath it, and where supported on steam and spheres of water it will slide with comparative ease, simply because the water will always be surrounded by an atmosphere of steam, and the effect will be as though the valve were actually balanced to such an extent. When properly and moderately lubricated, the place of some of the water spheres will be taken by sphericles of oil, and these, being supported all round by the steam surrounding them, will bear up the valve efficiently.

Suppose, now, that a heavy flush of oil be injected into the valve chest The immediate result will be that oil takes the place of the water between the working faces; it displaces all the pressure, vapor-producing material, and the valve no longer slides upon a multitude of water spheres, but on a continuous sheet of oil; it is no longer considerably equilibrated by pressure beneath it, but the full effect of the steam pressure at its back takes effect in forcing it down upon the working face of the cylinder, and the oil film grows quickly thin, and the friction becomes enormous for a short time, and causes the severe vibration observed. After a few strokes the oil is so far squeezed down that its continuity is broken; steam and water get under the valve; the remaining oil breaks up into spheres, and these are supported by the steam around them, and just at this time the vibration ceases, and the valve works smoothly. A lubricator which will preserve this quality of lubrication, that is, a combination of oil and water, will best secure efficiency. Such is the explanation that has seemed to reasonably satisfy the writer as to the peculiar observed effect of over-lubrication of slide valves. It seems to show good cause for what otherwise might appear anomalous, and is certainly satisfactory, as explaining the very superior efficiency of continuous feeble lubrication such as given by the sight-feed continuous lubricators now so much used.

If such is a true reading, then it would appear that lubrication, to be efficient, must be partial, and that a combination of oil with vapor-producing water is better than all oil. Oil requires a temperature of some 600 degrees to vaporize, and is thus not of service in producing an uplifting pressure between the working faces. Water by itself is too non-coherent to serve as a lubricant, and a valve might easily become dry if only left to such water as could remain beneath it. The addition of a little oil assists to retain water upon the slide surfaces. The water gives to the oil particles the supporting lateral pressure, which preserves them spherical against the crushing pressure of the valve, and the vapor of the water also, to such an extent as it occupies the area of the valve face, gives an upward pressure as great as the downward pressure over an equal area of the valve back. Every slide valve has a particular degree of lubrication suited to it, and this is found out by a good engineer by observing the ease or otherwise with which the spindle moves, either by the eye or hand, for often the striking of the valve is painfully visible in the jerking movement of the valve spindle. Clearly, the proper degree is that which keeps the valve floating on a large number of oil spheres, not so closely spaced as to coalesce and displace the water and steam, and it is very clear that such a condition can never be attained by intermittent supplies of oil, but that lubrication must be steady and continuous, and when effected by drops as from sight-feed lubricators, these are as well arranged that the drop through the sight-tube shall be directed as a steady flow into the steam pipe, a rapid series of small drops being preferable to an occasional large drop.

Lubrication is only just beginning to be understood. It will soon be recognized that oil itself requires lubricating. A heavy oil may be absolutely necessary for certain heavy bearings, and yet it may be found that a little thin oil reduces friction. The heavy, thick oil is a support, but is too cohesive. Its supporting power will not be reduced, but its stickiness will, by an admixture of lighter oil. No one would refuse to lubricate the ball bearings of a bicycle, and yet the case would be almost a parallel to refusing to mix heavy and light oils, especially for bearings of heavy shafts and sliding pieces.

The existence of a slide valve must also depend very largely upon its construction in respect to stiffness. A flexible valve shows evidence of being more or less deflected and bent in passing over port openings. If not strongly made, a heavy steam pressure will cause a valve to deflect, and when a valve deflects it requires more power to work it than if it stiffly bridges the port openings.

The common English practice of using gun metal as the material for locomotive slides, with a view to preservation of the cylinder faces, does not appear warranted, if we must judge by the experience of American locomotives, which have cast-iron valves, or, indeed, the experience of English engineers in stationary work; for both slide valves and piston valves, as well as Corliss valves, are almost invariably made of cast-iron to work on cast-iron faces. Locomotive engineers who think a valve has given a good record if it has worked three million revolutions, should ponder the ninety or even two hundred million revolutions of the stationary engine slides. In this respect, however, the difficulties under which the locomotive is required to work must not be overlooked. It is largely due to the variation of the valve travel that the wear is severe, as a short travel hollows out the cylinder face, and the occasional larger travel, as at starting, is accompanied by leakage of steam. Slide valves are thus seen to be unsuited to a variable travel; their movement should be constant, and they should always travel beyond the raised portion of the port face, to avoid formation of ridges.

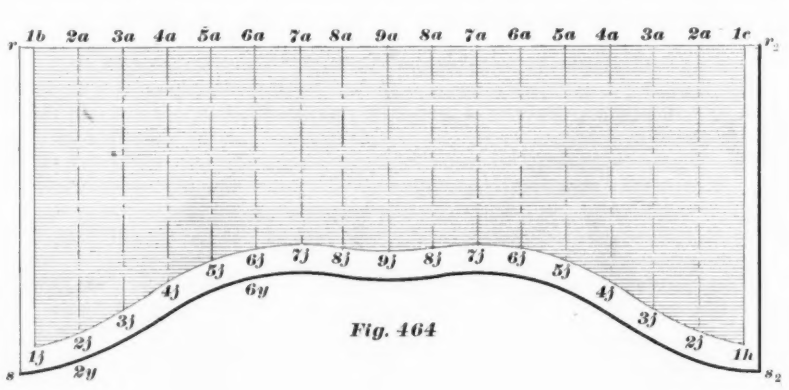


Fig. 464

It is common, too, in slide valves, to find the attachment of the spindle at a point considerably removed from the face of the valve, as in Fig. 1. In a short valve especially such a method is liable to cause a tipping motion and wear of the steam edges, and therefore leakage.

For perfect working, the center line of the valve spindle should be in the plane of the working face of the valve, which, of course, requires a special form of bridle. Still, without going to such an extreme, the designer should always contrive to keep the line of thrust and pull of the valve spindle as near the plane of the working face as possible.

Though slide valves absorb a good deal of power to move them, it must not be overlooked that the friction which calls for the power is manifested again as heat of the working faces, and to such an extent is not all loss, as a portion of such frictionally generated heat is absorbed by the steam, and this is dried or superheated more or less, and to such an extent rendered more efficient. This method of drying steam is, however, not commendable, and is no excuse for neglecting scientific lubrication.

Though in Germany there are nearly twice as many grade crossings as in Massachusetts, there are twelve times as many people killed in Massachusetts, making the crossings about twenty-four times as destructive to life.

Practical Drawing.

By J. G. A. Meyer.

SEVENTY-FIFTH PAPER.

555. It will be advantageous to reflect and consider the mode of procedure in the solutions of the practical problems given in some of the preceding papers. Take for instance the last problem, which required us to find the development of a portion of the shell of a boiler, as shown in Fig. 462 (see last paper). Before we found the outline of this development we first made, on a blackboard, two preliminary views, as shown in Figs. 461 and 461*a*, of the plate to be developed. Now let us examine more closely these preliminary views, and thus impress upon the mind the principles which should govern us in making such views and similar ones for the solution of other practical problems; by so doing we will also obtain a clearer conception of how closely practice and theory are connected.

We know that in rolling a plate of iron into a cylindrical form, one of its surfaces will be stretched and its other surface will be compressed; and since it is generally assumed that one will be stretched as much as the other one will be compressed, there must be some portion of the plate which will undergo no change in length, and this portion will lie in the center of thickness of the plate. Here, then, we have something positive to rely on, and therefore, in laying out a plate which has to be rolled to a cylindrical form, we take only the center of thickness into consideration, and proceed exactly as if the plate had no thickness, and assume that it has length and breadth only. But a body which simply has length and breadth and no thickness cannot be a material object or physical body; it is a geometrical magnitude (see Art. 19), and, according to the definition of such magnitudes given in Art. 25, it is simply a surface.

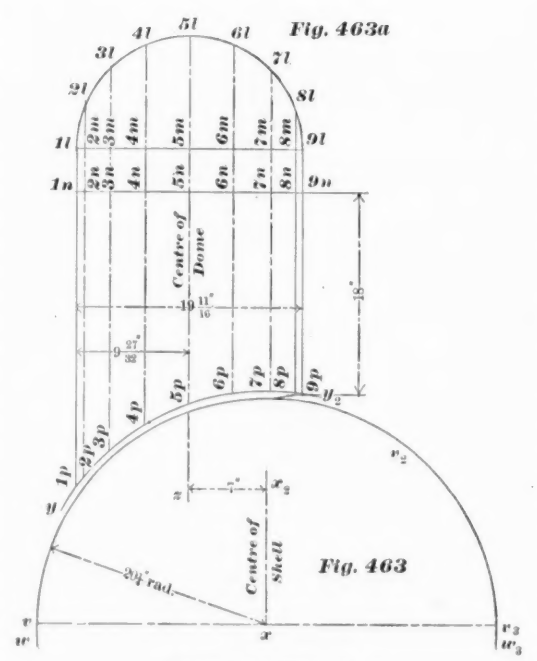


Fig. 463a

Fig. 463

Practical Drawing.

The arc *a b c* in Fig. 461 (last paper), represents the center of thickness of the plate; and the arc *d* 4*d* 5*d* in Fig. 461*a* represents the center of thickness of the flange; in fact, the whole outlines in Figs. 461 and 461*a* represent a geometrical magnitude. Here, then, it must be perceived that the first step taken in the solution of our practical problem was to reduce it to a geometrical one; in fact, all practical problems involving the development of curved surfaces must first be reduced to purely geometrical problems. Indeed, we may broaden our remarks and say that all problems relating both to curved and straight surfaces are reduced to geometrical ones.

Comparing now the auxiliary lines 5*a* 5 *d*, 4*a* 4 *e*, etc., in Figs. 461 and 461*a* with the auxiliary lines 8 *g* 8, 7 *g* 7, etc., given in Figs. 404, 405 (sixty-fifth paper), we find that we have simply followed the principles given in Problem 76; in short, in the solution of our practical problem we have applied the principles of geometry. Some of our readers who have often laid out boiler work successfully may be unconscious of this fact, nevertheless it is true that they have followed the principles of geometry, otherwise work of this kind cannot be laid out correctly.

In a similar way it can be shown that in finding the development Fig. 458 (seventy-third paper), we have again applied the principles given in Problem 76. It will be advantageous to the student to again study this problem in connection with laying out the plates just referred to.

We may now sum up the whole matter by saying that, in finding the development of any plate which has to be rolled or bent to a cylindrical form, first reduce the practical problem to a geometrical one, and then follow the principles of purely geometrical problems which have been previously given, and afterwards make the necessary allowances for lap and flanges in a manner as explained in the foregoing problems.

Although so far our practical problems have involved only cylinders with circular bases, yet the same principles are applicable to the development of the surfaces of cylinders which have elliptical or other forms of bases. (See definitions in twenty-ninth paper.)

In the foregoing practical examples relating to the development of cylindrical plates one of the cylindrical forms has been placed centrally over the other one; for instance, in Fig. 446 (seventy-first paper) we see the dome placed on the center of the shell. In practice it often occurs that the dome must be placed out of the center of the shell. In finding the development of the plate for such a dome, no other principles than those already given are needed; yet, since the preliminary views on the blackboard have to be a little more complete than those given in previous problems, it may be well to explain the manner of finding this development.

Problem 83*c*.

556. The distance between the center of a dome and the center of shell, Fig. 463, is to be 7 inches; the outer diameter of the shell, 40½ inches; outer diameter of the dome, 20 inches; height of dome, 18 inches; thickness of metal in dome and shell, $\frac{5}{16}$ inches; it is required to find the development of the dome sheet; and also the shape of the hole in the plate for the shell before it is bent.

Our first step will be to draw on a blackboard two preliminary views such as are shown in Figs. 463, 463*a*. To do so, draw the horizontal line $v\ v_3$ and the vertical line $x\ x_2$, cutting the former in the point x; from this point as a center, and with a radius of 20¼ inches (one-half of the outer diameter of shell), describe the arc $w\ v_2\ w_3$; the amount $v\ w$, and $v_3\ w_3$, represents one-half of the horizontal lap. Again, from x as a center, and with a radius of $20\frac{13}{32}$ inches, draw an arc $y\ y_2$; this arc represents the center of thickness of the dome flange. At a distance of 7 inches from the center line $x\ x_2$, draw the vertical line $z\ 5l$; this line represents the center line of the dome. At a distance of $9\frac{27}{32}$ inches from $z\ 5l$, draw the vertical line $1n\ 1p$; also at a distance of $9\frac{27}{32}$ from $z\ 5l$, draw the vertical line $9n\ 9p$; and at 18 inches above the arc $w\ v_2\ w_2$, draw the horizontal line $1n\ 9n$, terminating in the verticals $1n\ 1p$, $9n\ 9p$. At any convenient distance above $1n\ 9n$ draw the horizontal line $1l\ 9l$, cutting $z\ 5l$ in the point $5m$; from this point as a center, and with a radius of $9\frac{27}{32}$ inches, describe the semicircle $1l\ 5l\ 9l$. Divide the arc $1l\ 5l\ 9l$ into any number of equal parts, say eight, and through the points of division $2l\ 3l\ 4l$, etc., draw vertical lines cutting line $1l\ 9l$ in the points $2m\ 3m$, etc.; also cutting the line $1n\ 9n$ in the points $2n$, $3n$, etc., and meeting the arc $y\ y_2$ in the points $2p\ 3p$, etc. This completes the preliminary views on the blackboard.

Comparing the mode of procedure in the present case with that given in Problem 83*c*,

we find that in the main the two are identical. In both cases we have shown the center of the thickness of the dome plate, and the center of thickness of the flange; we thus reduce the practical problems to purely geometrical ones, thereby enabling and justifying us to throw out of mind, in the solution of our problems, all ideas of thickness and kind of material to be used, and proceed as if we had to develop a geometrical surface only; that is, a magnitude which has only length and breadth, but no thickness. Such a mode of procedure greatly simplifies the problems; and since all practical problems may thus be reduced to geometrical ones, we have the means at hand with which we can solve the most difficult problems which may present themselves in practice.

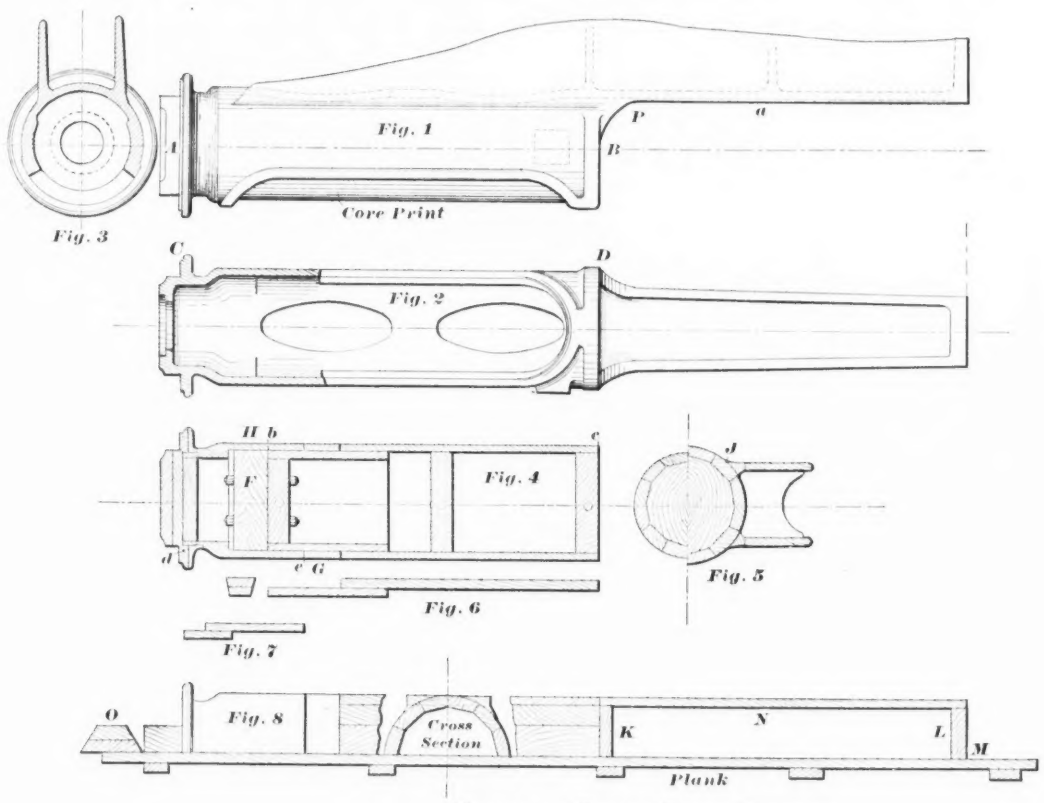
But now notice the difference between the appearances of the two views shown in Figs. 457, 457*a* and those shown in Figs. 463, 463*a*. In the former we have shown only that portion of dome which lies on the left-hand side of its center line *x* 6*l*; in the latter we have shown those portions of the dome which lie on the left and right-hand side of its center line *z* 5*l*. It may now be well to examine the reason for this difference. In Fig. 457 we really see only one-quarter of the dome; the other quarter is hidden, and it must be obvious that the development of the hidden portion must be exactly like the development of that portion which is exposed to view; and therefore it is only necessary to show one-quarter of the dome in Fig. 457*a*. Again, if we had shown in Fig. 457 that portion of the dome which lies on the right-hand side of the center line *x* 6*l*, we would have a repetition of that which we have already shown, because in this case, the dome being placed centrally on the shell, the portion of the dome shown on the left of its center line *x* 6*l* will be exactly like that which has been omitted; therefore, for the purpose of finding the development, it will be a waste of time to show anything more than we have done. Again, since, in Fig. 457*a* it is necessary to show one-quarter of the dome only, we have good reason to believe that if the development, Fig. 458, be divided into four equal parts, these will be equal to each other; and, indeed, such is the fact; if, for instance, we cut the shaded portion of the development through the lines 6*a* 6*y*, 1*a* 1 *j*, 6*a* 6 *j*, and lay these four parts, one on top of the other, their outlines will coincide.

In Fig. 463 the dome is not placed centrally on the shell, and consequently that portion of the dome which lies on the left-hand side of its center line *z* 5*l* will not be like that on the right-hand side of the same center line; hence, the necessity of showing both these portions of the dome. Again, in this figure we really see one-half of the dome, the other half is hidden; and it must be obvious that the hidden portion must be exactly like that which is exposed to view; therefore, in Fig. 463*a* we must show one half of the dome; anything more than that is unnecessary, and anything less than that is not sufficient. Lastly, since in Fig. 463*a* we have shown one-half of the dome, it is reasonable to expect that one-half the development in Fig. 464 must be equal to the other half; and such is the fact; if, for instance, after the development has been found, it is cut through the line 9*a* 9*j*, and one-half placed on top of the other half, the outline of the two parts will coincide.

Fig. 464. To find the development, make the horizontal line 1*b* 1*c* equal to $19\frac{11}{16} \times 3.1416$, that is to say, equal to the circumference of a circle whose diameter is $19\frac{11}{16}$ inches. Divide the distance from 1*b* to 1*c* into twice as many equal parts as have been spaced off on the semi-circumference 1*l* 5*l* 9*l*, Fig. 463*a*. Through the points of division 2*a*, 3*a*, 4*a*, etc., draw vertical lines 2*a* 2*j*, 3*a* 3*j*, 4*a* 4*j*, etc. Make the line 1*b* 1*j* equal to 1*n* 1*p*; 2*a* 2*j* equal to 2*n* 2*p*; 3*a* 3*j* equal to 3*n* 3*p*, and so on, as indicated by the figures prefixed to the letters. Through the points 1*j*, 2*j*, 3*j*, etc., draw a curve, and thus complete the outline of the shaded part of Fig. 458, which represents the development of the dome plate without any allowance for lap or flange. To make this allowance, proceed in a manner similar to that explained in Problem 83*c*. Instructions for laying out the rivet holes are unnecessary, as the same mode of procedure is followed as given in Problem 83*c*.

Directions. On one of the sheets of drawing paper 20″x15″ find the development of the dome of such dimensions and position on the shell as are given in this example. Use 3-inch scale. It will be beneficial to the student, not to use a T or set square for drawing the outlines shown in Figs. 463, 463*a*; nothing but a straight-edge should be used, and proceed in a way similar to that he would be compelled to adopt in drawing these views full size on the floor, where it is not convenient to use squares.

From this the student should not infer that he may be careless, and is allowed to draw these lines at random. The outline must be as accurate as it can be made with the T and set squares. Great accuracy is of the utmost importance in the solution of all these problems. Here the question may arise: How can we draw a line perpendicular to another one without the use of a square? The answer to this question will be found in Problems 1 and 2 (ninth paper).



MAKING AN ENGINE FRAME PATTERN.

Making Engine Frame Pattern.

BY P. S. DINGEY.

Patterns for engine frames of the type shown in Figs. 1 and 2 are made in many ways, and among a number of ways it may be difficult to decide which is the best for both pattern maker and moulder, for in all such jobs the moulding and pattern making should be considered together.

I propose to show here the way we build our frame patterns. Figs. 1, 2 and 3 are three views of the frame to be built. Fig. 2 is shown in part section toward the cylinder end of frame, and Fig. 3 is a cross-section showing the two ribs on the back which makes the frame rigid. The pattern is to be parted on line *A B*, Fig. 1, and to mould with the two ribs down. That part, from the center line *A B* to *a* in Fig. 1 can be lifted with the cope, or it may be lifted out with an anchor plate and set in on chaplets. This pattern is also made on the same principle as the Corliss cylinder that appeared in the AMERICAN MACHINIST January 10 and 24, viz., to slide. By doing this, different stroke engines can be made from the same pattern. Provision for this change must be made between the points *C D* and *D E*, in Fig. 2, but the part between *C D* will only be made to slide, while the length *D E* can be changed by making a false end to be used for stopping off to the desired length.

We start the pattern by building up two half-round pieces, one to be larger in diameter than the other; the smaller will be the diameter of the inside of frame, and will therefore serve as a core print, and the larger for the outer diameter of frame. The end views of these two parts are shown in Fig. 5; their length is from *b* to *c* in Fig. 4. Notice that on one end of the larger part the end is turned down to the same diameter as the small part; this is for the sliding end to slide on.

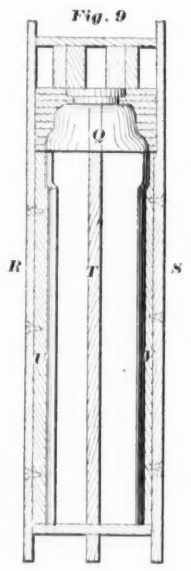
Get the staves out for building the larger part, and glue on an extra thickness, forming a step as shown in Fig. 6. After building the two parts, put them together and turn, but as one part is larger than the other, they must be balanced before turning. It will be seen that only the large piece and the end of the smaller can be turned; the rest of the print will have to be planed off. Next, get some staves out like Fig. 7, to make the sliding end *H*, shown in Fig. 4. The length of this will be from *d* to *e*. The flange is glued up in two courses, and fastened around this sliding end *H*. The end piece that receives the cylinder should not be fastened on permanently, as one frame does for two sizes, or it may be three sizes of cylinders, so that instead of putting on and taking off a lining, it is better to make two or three ends for changing.

In Fig. 4 the pattern is shown arranged for the longest stroke. *F* is a piece bolted on the end at *b* to give more bearing to the sliding end *H*. *G* is a filling piece, and whenever it is necessary to shorten the frame, these two pieces, *F* and *G*, can be easily taken out and the sliding end moved up and screwed again. On referring to Fig. 1 it will be seen that the half of this sliding end that goes around the print has to be cut out circular, like the front end in Fig. 2, and moulding fitted around it. In making the moulding that is shown around the edge of frame, it should be made loose from the print, thus making strong loose pieces, less likely to be broken.

That part of the frame that covers the print should now be fitted on. Having the round part of frame ready, get the ribs built on the back by first planing two flat places on the pattern where these ribs connect to the body, wide enough to take a piece that shall form the inner and outer fillets at bottom of ribs; see *J*, Fig. 5.

Fig. 8 shows the large part of pattern with cross-section; it is laid on a plank that is surfaced; on this plank a center line is struck as a guide for getting the other part of frame in line with the body; after locating the center line on pattern by that on the plank, fix a temporary piece, *K*, Fig. 8, on the end, and also a piece *L* the same height. The point *M* shows the full length of frame; these two pieces, *K* and *L*, are temporary supports for locating the straight part of frame. On these supports square up a center line from the plank; see cross-section, Fig. 8. The straight part, *N*, should be level with the top, as seen in cross-section, so that the two ribs can have a straight bearing from end to end.

Now is the best time to bore some holes through the body of pattern for screwing on the ribs. It will strengthen the pattern to glue some dowel pins through the body and down into the ribs. Having put this part together securely, proceed to fit in the brackets at *P*, Fig. 1, remembering that the inside of these brackets should match the inside of frame. The two lightening holes at the back, seen in Fig. 2, are cored. These two cores will serve to rest the main core on.



On the cylinder end of frame the print is made as shown at *O*, Fig. 8, the object of this being to enable the moulder to set the core in so that the guides shall come in their right position.

Having completed the pattern, make a half skeleton core-box for the inside of frame. This box is seen in Fig. 9. First build an end as shown at *Q*, and though but one-half be needed, it will pay to build a full circle and turn it out. After cutting in halves take one and screw on three pieces, *R*, *S*, *T*. To *R* and *S* screw on two other pieces, *U V*, for the guides. This skeleton box is arranged for the longest, and when changing length of frame all the change that the core-box will require is to fit a piece in the plain end to the desired length.

There may be some who would object to casting the frame as described, viz., with guides up and ribs down. All I can say to that is, frames of this style we cast that way, and we get the guides good and sound every time.

The longest pendulum on this continent swings in the technological school at Atlanta, Georgia. It is a heavy pear-shaped piece of iron attached to a brass wire forty-two feet long. The upper end of the wire is pivoted in a steel point which rests on the center of a steel plate so as to cause the least possible friction. The swinging of the pendulum gradually describes a circle on the floor in a direction following the sun, showing in this that "the earth do move." Directly under the pendulum is a large circle divided into twenty-four parts, of fifteen degrees each, to correspond with the hours of the day. The north pole is placed directly under the pendulum, and the meridians of longitude meet there. The parallels of latitude make smaller circles inside the first.—*Philadelphia Times.*

A New Form of Pin-Gear Tooth.

BY GEORGE B. GRANT, LEXINGTON, MASS.

When one gear of a pair has teeth of the form of round pins, we have a case of pin-gearing. This form of gearing, on account of its simplicity and ease of construction, is one of the oldest known, and is still in common use for clock work.

The term "pinion," commonly used to designate the smallest gear of a pair, is probably a corruption of "pin one," as the pin gear is almost always the smallest gear of the pair.

The form of the tooth of the pinion being given as a circle with center on the pitch line, the problem is to determine the form of the tooth of the gear to suit that condition. This problem was treated by Willis and the earlier writers on mechanism as a very simple one, but MacCord shows that it is really very difficult, on account of a feature that was evidently overlooked until he investigated the subject.

The difficulty, briefly stated, is that the parallel to the epicycloid formed by the center of the pin, which is the true tooth curve to run with the pin, is not the simple line that Willis supposed it to be. MacCord shows that it is a complicated curve having a cusp, as shown by Fig. 1, and that there will be an interference between the body of the pin and one of the branches of the cusp that will cut away a part of the working curve of the tooth, and thereby limit its action.

As roughly indicated by the figure, the curve $a\ b\ c$ that forms the working face of the tooth has a cusp at b, which, in certain positions, is inside the body of the pin. The working curve is cut off at the point d, and so mutilated that it will not begin to act on the body of the pin until the point h is reached.

This difficulty exists in all cases, and is most troublesome when the pins are on the larger gear of the pair. When the "pin one" is much the smallest, the interference is not troublesome under ordinary practical conditions.

The purpose of this article is to show that this troublesome interference can be easily and completely avoided by setting the center of the pin back from the pitch line, as shown by Fig. 2.

If the center of the pin be placed at the point C, inside the pitch line, the whole of the outline of the pin is a true odontoid, while half of it cannot act as a tooth curve, under any conditions, when the center is on or outside of the pitch line.

If the center of the pin is set at the right distance, $C\ M$, inside of the pitch line, the curve, $O\ P'\ N'$, of the tooth that works with the pin, will be without a cusp, so that there can be no interference with the body of the pin.

The action will follow the line of action $p''\ O\ P'\ N''$, so that there will be approach as well as recess.

The mathematical determination of the distance $C\ M$, for which the derived tooth curve will be without a cusp, is very difficult, except for the single case of the pin-rack.

For the pin-rack we have the formula

$$x = \frac{2}{27} \cdot \frac{d^2}{D}$$

in which x is the required distance $C\ M$, D is the diameter of the gear, and d is the diameter of the pin.

Using this formula for the case of a gear of twelve teeth running with a pin-rack, the diameter of the pin being half of the circular pitch, we find that the distance x is less than one one-hundredth of the diameter of the pin. It is seen that it takes but a very slight change in the position of the center of the pin to make a complete change in the form of the derived tooth curve, and to entirely avoid the difficulties that MacCord has pointed out.

The graphical determination is a matter of trial, and may be accomplished as follows:

Set the center C back of the pitch line a distance that appears to be sufficient; from any chosen point P on the pin, draw the radial line $P\ C$; draw the radial line $D\ A$ from the intersection D; lay off the arc $O\ D'$ equal to the arc $O\ D$; draw the radial line $D'\ A'$; make the angle $A'\ D'\ P'$ equal to the angle $A\ D\ P$; make $D'\ P'$ equal to $D\ P$, and the point P' will be a point on the tooth. In action the points P and P' will come together at P'' on the line of action $p''\ O\ P''\ N''$, where the angles $P'\ O\ A'$, $P'\ D'\ A'$, and $P\ D\ A$ are equal, and the distances $O\ P''$, $D'\ P'$, and $D\ P$ are equal.

Several points may be found by this process, and the cusp will be seen if there is one.

Any point p' on the face curve can be found by the same process, substituting small letters for the capitals of the foregoing description.

When the power to be transmitted is light, there is no form of tooth equal to the pin-tooth, for the pin can then be a roller turning on a shaft S, Fig. 2. The friction between the roller and the tooth is rolling friction and very small in amount, while the sliding friction is confined to the surface bearing between the roller and the shaft.

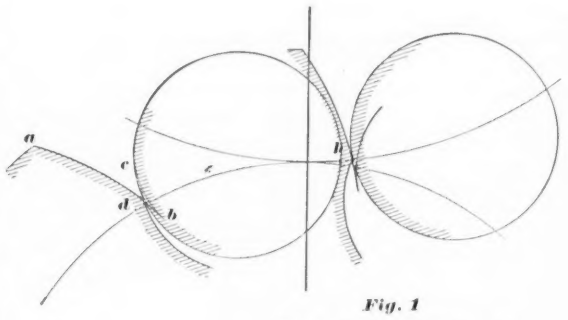


Fig. 1

The ordinary Pin-Tooth

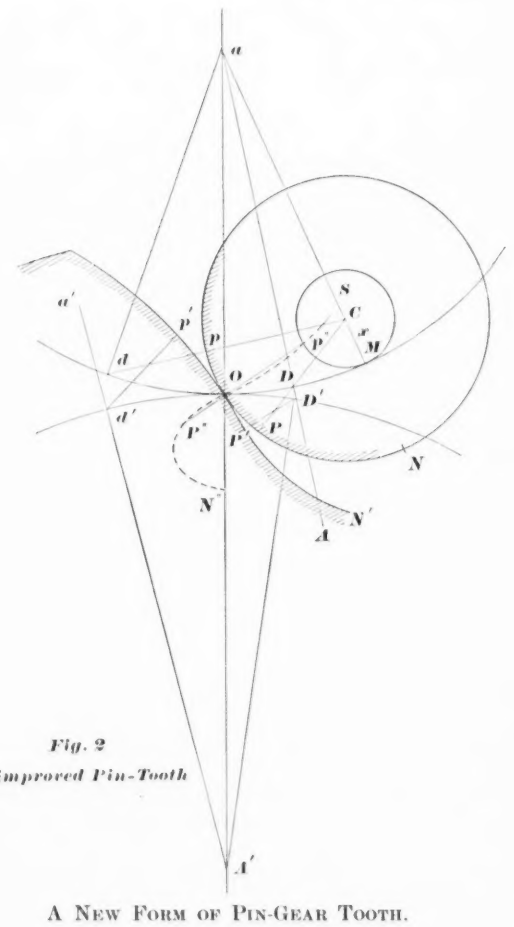


Fig. 2

The improved Pin-Tooth

A NEW FORM OF PIN-GEAR TOOTH.

These principles, which are those of the "normal theory" of the tooth curve in general, were contained in an article contributed to the AMERICAN MACHINIST several years ago, and afterwards printed in the second edition of my Handbook on the Teeth of Gears. They were then applied to the very similar problem of the segmental gear tooth.

Vessels of great strength and resistance to the action of acids have, according to *La Chronique Industrielle*, been made in Munich from perforated sheet iron, which is heated to redness, coated on both sides with chloroform, placed between sheets of india-rubber, submitted to great pressure, and vulcanized. The rubber is clinched through the perforations, and adheres firmly to the iron.

He who works hardest does not necessarily accomplish most.

Some Uses of the Yielding of Metals to Pressure.

BY JARNO.

The illustration of an expansion reamer in the AMERICAN MACHINIST of January 17th is interesting, inasmuch as it suggests other and useful applications of the yielding property of metals, and calls to mind some that have been made and are successful.

I think that an expansion shell reamer like Fig. 1 would work well. A, A, is the shell whose ends are beveled as at D, D'. The hole in the shell is tapering and fits on the shank at B. A slot, E, is cut through the body of the shell, and across the end D', are two slots C, C, that fit over the screws G, G. On the end of the shank is the nut F. Both the nut and the shank are beveled at D, D', to fit the ends of the shell. When the nut is screwed up tight, the shell is rigidly held in upon the shank, by both the beveled part of the nut D, and the shoulder D'. The screws G, G, keep the shell from slipping. In place of the screws a plain pin can be used. To expand this reamer the shell must be moved up on the taper shank towards D'. Before this can be done, something must be taken off, either from the shoulder, or from the shell, at D'. Though not, perhaps, very convenient to expand, yet, because it will be so rigid, I think this will be a good form of reamer whose size is to be changed only to take up wear.

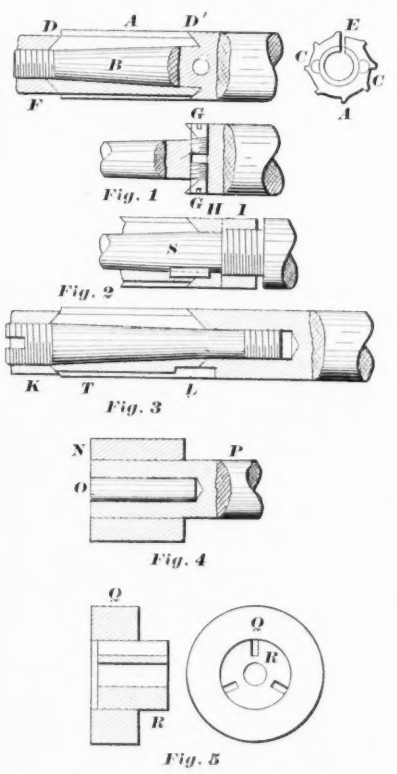
Fig. 1 is not an adjustable reamer, as it can be only expanded. It can be made adjustable by adding a shoulder sleeve, H, and a nut, I, Fig. 2. A key is let into the shank and a key slot is cut inside the shell. The sleeve can be moved endwise in either direction, thus permitting the shell to be held in different positions upon the shank. By fastening the shell upon a larger or smaller part of the shank, the reamer can be made to cut larger or smaller, as required. I do not think this reamer would be so rigid as Fig. 1.

Fig. 3 is a variation of the taper shank principle, applied to an adjustable reamer. A screw, S, having a tapering body, is threaded into the shank. The large end of the screw is threaded and carries the nut K. Upon the screw is held the shell T. Unlike Fig. 1, the hole in the shell T is smallest next to the shank. If the screw S be set deeper into the shank, the shell will be adjusted to cut larger. The reamer will cut smaller as the screw is drawn out of the shank. The key, L, fastened into the shank and fitting into a slot in the shell, keeps the shell from slipping. Generally, the weakest part of a shell reamer is the pin or key that is intended to keep the shell from slipping on the shank.

My acquaintance over the way, Gascon, does not think much of these expansion reamers. He is of the opinion that he can buy a new reamer at a less cost than he can expand Fig. 1. As in many other things, I suppose that neither he will change his opinion, nor I mine, without experimental proof. He also thinks that a man shows a weakness in suggesting so many ways of doing a thing, and that one who is so fruitful in methods is himself not sure that any of them are good.

An instance, in which the yielding of metal helped a workman out of trouble, will be understood from Fig. 4. A number of rods, P, that should be driven into hubs N, were made too small. A hole was drilled into the end of P, and a pin, O, somewhat larger than the hole, was driven in and squared off. The rods were expanded to the right size.

An interesting, and to me quite surprising instance of metal yielding will be understood from Fig. 5. This is a gauge for cylindrical pieces, the size of which is tested by putting them into the hole in the bushing R. The outside of this bushing is tapering, one sixty-fourth to one, and fits into the collar Q. In the bushing three slots are cut from the outside, leaving solid stock around the hole. The gauge before me is for quarter-inch work; the stock around the hole, at the bottom of the slots, is five sixty-fourths inch. The bushing is hardened. Now, the interesting thing about this gauge is, that when the hole is worn it can be contracted by forcing the bushing farther into the collar. Gauges similar to this one have been in use for years.



YIELDING OF METALS TO PRESSURE.

Care of Steam Boilers.

BY WM. J. WILLIAMS.

A great deal has been written from time to time on the management and care of steam boilers. Some of it has been of an advertising nature, and has evidently been written by those whose practice has been chiefly on paper.

In thirty years' experience with boilers, I have come across the advocates of various practices in the care of boilers, some of which was said to be the only practice to bring about absolute freedom from scale. But I have found that all wind up about the same: with a boiler incrustated more than is desirable.

Much can often be done to delay this state of things, but a way to entirely prevent it in steam boilers using natural waters has never yet come to my notice. To lay down a course of treatment, with everything at hand that one's heart could desire for the asking, would be quite a different affair from where almost absolutely nothing will be furnished, not even a scaling pick. Therefore one is left entirely to his own resources. Boiler cleaning is an expense, and is therefore to be avoided as much as possible.

There is one practice which seems to be in high favor, and is supposed to be a great advantage in keeping a boiler clean and in good condition. That is, emptying it of all its water every two weeks or oftener, and refilling it again without internal inspection. If it is a good thing to empty a steam boiler of all its water every two weeks, it would be a

better thing to empty it every week, and still better to empty it every day, which is impracticable. The question is, how often, then, should a boiler be emptied of all its water? I have never yet met with a case where it was necessary to do so every four weeks, but I do not wish to be understood as saying there are no such cases. But to assume that a boiler should be emptied every two weeks or oftener is a blunder, and contrary to reason. No boiler, after being emptied of its water, should be refilled until after an internal inspection; this alone in every instance will mark the period of time that that boiler may be allowed to run without being emptied.

In nine cases out of ten, where it is the practice to empty and refill without inspection, were it made obligatory to inspect internally, previous to refilling, the practice would be abandoned, solely on account of the expense. Instances are not rare where steam boilers are subjected to a bi-monthly emptying, and not a solitary thing more is done for their preservation for months at a time. Perhaps twice, in some cases three times a year, they may be scaled; in the meantime the flues have become choked with ashes to such an extent that it makes it difficult to run anyhow, and something must be done.

What must be the state of affairs in and about a steam boiler to make it necessary to empty it of all its water? We will assume that a certain boiler has been at work two weeks; the water in it is clear, there are no leaky joints, the safety valves are in good order, all attachments are in good condition, it is not even suspected that there is anything wrong anywhere. What shall this boiler be emptied of its water for? To this it may be replied: To blow out any collection of loose scale and dirt that may be in it. If the blow-out pipe is situated in the right place, and the blow-out cock has been judiciously used ever since the boiler has been set to work, there will be nothing there to blow out, and if the blow-out pipe is not rightly situated the boiler ought not to be totally emptied, unless it is intended to make an internal inspection. If everything is in good order it is not justifiable to empty the boiler of its water at this time; but, according to a miserable custom, the boiler must be purged of a quantity of water that is measurably better than that which takes its place. In addition to this, the boiler is subjected to a punishment at an unreasonable time, by being roasted by the still hot brickwork, and exposed to currents of air much below its own temperature.

Another question comes up: Shall the damper be opened or closed when a boiler is being emptied of its water? Usually there are only a few hours between emptying and being at work again, so there is little choice; it is get to work again as soon as possible. There is no money making while boilers are being cleaned.

To lay down or compile a set of rules for the care of all steam boilers, no matter how situated, would be rather difficult. What would be good treatment in some cases would be very bad for others. While one boiler may be safely emptied in an hour after the fire has been drawn, it would be ruination to another. Whenever the water contained in a boiler becomes fouled, from any cause whatever, usually long-continued rains washing the soil into the source of supply, and all efforts at the blow-out cock, and surface blow, if there be one, fail to clear the water, and the source of supply has returned to its normal condition of purity, then the boiler should be emptied and refilled with that which is better, but not before the boiler has been opened and purged of any objectionable matter contained in it. To not refill with the better water would be wrong and unjustifiable, for more than one reason. Steam is best made from clear water; it is not at all desirable that any foreign matter should be carried along with it, for whatever purpose it may be used. Various practices are in vogue with the same kind of boilers, source of feed supply the same, steam pressures about the same, amount of work performed proportional, inspection risks taken by the same parties. Some are blown out each alternate week, others only twice a year. It is difficult to see where the mere act of emptying a steam boiler of its water is of any benefit, seeing that not a drop that was let out by the blow-out cock was there in the morning; but such seems to be the decree of some owners of this kind of property, and, like some other people, when spring comes they must take their treacle and sulphur, whether they stand in need of it or not.

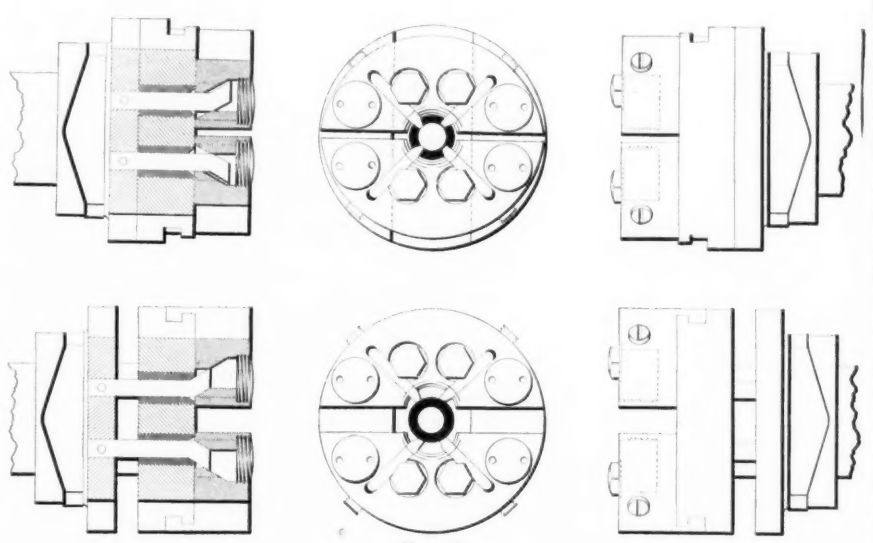


Fig. 1.

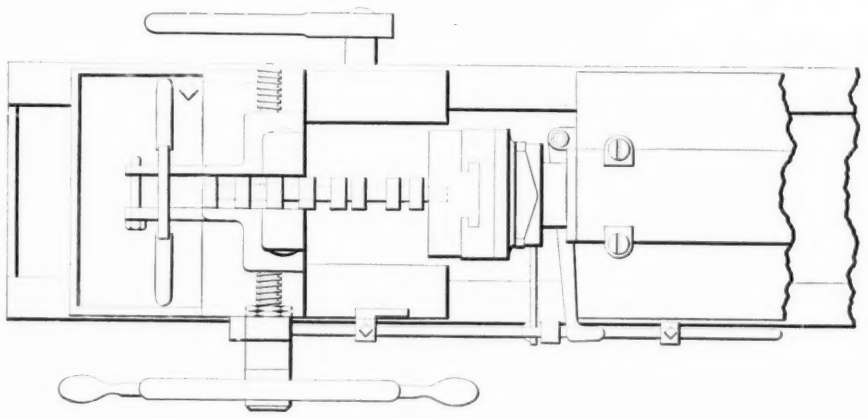


Fig. 2.

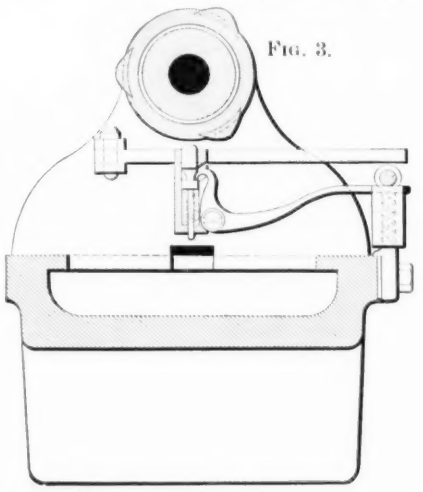


Fig. 3.

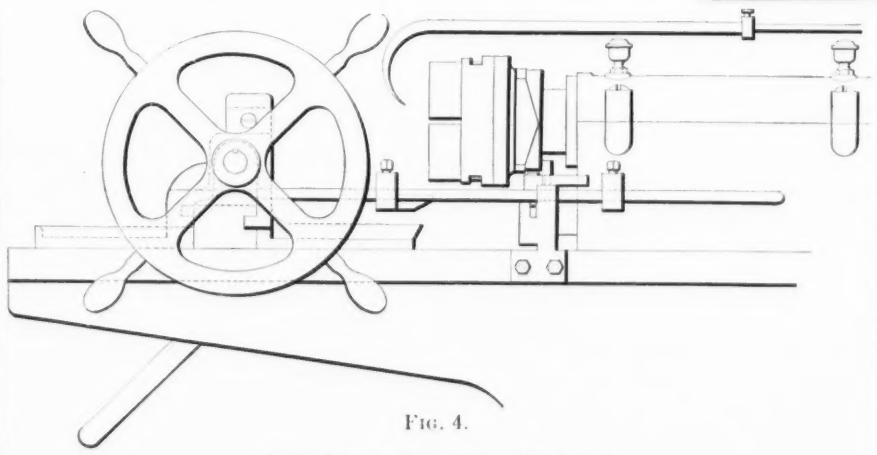


Fig. 4.

The Adams Threading Machine.

The Adams Automatic Threading Machine.

We present herewith engravings showing some recent improvements made in the head of the Adams automatic threading machine.

In this machine the dies, which are four in number, are firmly secured to two pieces called die holders, which slide to and from each other in T slots, to open and close the die. In this way the dies may be adjusted to size independently of the opening and closing mechanism, and as comparatively large and well-fitted surfaces are provided, upon which the sliding motion takes place, and upon which the rigidity of the head depends when cutting, most of the practical advantages of a solid die are secured.

Of the six views of the head grouped together, and designated Fig. 1, the three upper ones show the head closed, while the three lower ones give corresponding views, showing it when opened.

Each of the two sliding pieces has two steel bushes set into it upon an incline, in which work the correspondingly inclined ends of four bolts, which, as they are moved forward into the position shown in the upper left-hand view, close the die and lock it in the manner indicated. When these bolts are drawn back they open the head, as shown in the cut immediately below.

These bolts are fastened into a plate which is immediately back of the head, and is moved back and forth automatically from the motion of the carriage. Back of this plate, to which the bolts are secured, will be noticed a collar, upon which are formed inclined surfaces or cams, and it is the engagement of a stud with one of these cams which forces the plates back, and thereby opens the head. This stud is shown passing up through a projection which is upon the front of the head stock, just under the head, Fig. 3. It is seated upon a spiral spring, and is held down by the hooked end of a lever, the other end of which passes out to the side of the machine and rests upon another spiral spring, which is encased in a suitable piece bolted to the side of the bed. Fixed to the carriage is a rod upon which are two tappet collars, shown in Fig. 2; the tappet nearest the carriage having an inclined projection upon it, which, as the carriage advances, depresses the outer end of the lever, thereby releasing the stud and allowing it to rise by the action of the spring, so that it comes into contact with the cam surfaces upon the collar, which, as it revolves with the spindle, is forced back, and with it the plate and the four bolts, thus opening the head and allowing the bolts to be drawn out.

After the head is thus opened, one of the three projections shown upon the head, Fig. 3, comes into contact with the top of the stud, and forces it down again, and as the carriage has by this time been drawn back far enough to release the end of the lever, the spring forces it upwards, and it again engages the stud, holding it down. The carriage being drawn still further back, the other tappet comes in to contact with the horizontal lever above the one already referred to, and just below the head. This lever carries upon its upper side, and at a point directly under the center of the spindle, a stud, which is provided with a steel roller, which comes in contact with the back side of the collar on the spindle, and pushes it outward toward the head, closing it ready for another bolt. Short screw plugs are put into the holes in the front of the head, through which the four bolts are passed, and thus the working parts are well protected from chips and dirt, which might interfere with their satisfactory working. It is thus seen that the opening of the head is positive, being effected by the same power which drives the spindle, and that it requires no attention from the operator, either in opening or closing, after the tappet collars are properly adjusted upon the rod.

Four screws are provided, by which the cutters may be adjusted, and there are also four bolts which bind them firmly in place, as shown.

Fig. 4 is a plan view of the nut-tapping attachment. A holder is provided for the tap, by which it is driven in the spindle, and the nut holders are so arranged that any number of nuts which the strength of the tap will permit can be run on at the same time.

The builders are the Capitol Manufacturing Co., Chicago, Ill.

LETTERS FROM PRACTICAL MEN.

Forced Alignment for Type Writers.

Editor American Machinist:

Being interested in writing machines, I was glad to see in your issue of April 11th the account of the new Yost type writer.

Among other points claimed as improvements, is the system of forced alignment. The account says that one of "the essential points in which the machine differs from others of its class is in the securing of alignment at the point of printing, instead of depending for this upon the accurate adjustment of the type bars"; also, "these beveled surfaces *come in contact* at each impression, and *it is this contact* which limits the height to which the type rises, *as well as centering it in the guide*."

Now is this system really an improvement? It seems as though there might be some difficulty in making type in large quantities with beveled faces to accurately fit the guide.

Then in using different thicknesses of paper, and in manifolding, when from 10 to 15 sheets are used, will the type bars bed home to the beveled surfaces of the guide?

Supposing ink or dirt gets caked onto the type, won't this also prevent alignment? and won't those letters that are most used, such as the "e," be liable to wear quicker than the others, from the constant pounding of the beveled surfaces, and so soon get out of alignment?

Again, won't the wedging action, when the type gets dirty and gummy, tend to make the key action slow and heavy?

This question of forced alignment for writing machines was, I believe, thoroughly tried and condemned several years ago, but now it seems to be cropping up again, and is claimed as an *improvement*. Possibly, it is only a device to bolster up poor type bars.

G. I. Francis.

Jonson's Balanced Compound Engine.

This engine is of the trunk type, and consists virtually of four half cylinders with cranks set opposite, or 180°, forming, in fact, an equivalent for the ordinary high and low pressure cylinder, the area of the annular space between the trunk and low pressure or compound cylinder being equal to that of the high-pressure cylinder.

Thus, in the engine in the accompanying cut, the compound cylinder is 12½″ diameter, the trunk 9⅝″ scant, the difference in areas is 122.72—72.72=50, or nearly 8″, making this engine 8″ and 12½″ × 10″ stroke.

Steam is exhausted from the high-pressure end of each cylinder to the upper or compound end of the same cylinder, so that alternately the high-pressure end of one cylinder and its opposite compound one form a complete half stroke,

Excepting for electric lighting purposes, or for very large sizes, where the slide valves are of great area, the high-pressure steam and compound valves are in the same casting, the high-pressure exhaust passing through ports in the valve to the low-pressure end, and by giving the steam, compound and exhaust valves a definite lead, as determined by practice, both cylinders work in unison.

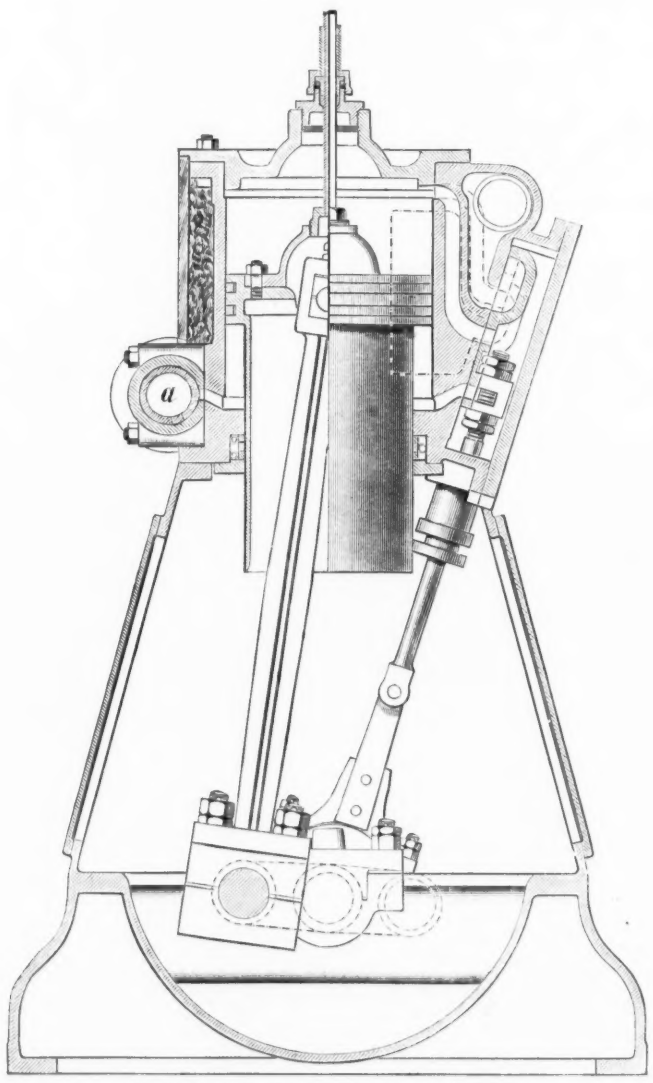
But the two valves being in the same casting, and driven by a single eccentric, or, in the case of the marine engine, by two eccentrics and the ordinary link motion, any change in this motion, as in using an automatic cut-off, affects the compound and exhaust as well as the live steam; hence, an independent steam valve, as shown in the cut, is used.

On marine engines the ordinary adjustable cut-off is used.

Where the valve area is very large, it is preferable to divide them.

The advantages claimed for this engine are compactness, freedom from vibration, low center of gravity, and, all the moving parts being exact reproductions of each other, a perfectly mechanical balance.

These engines are made by the Jonson Foundry and Machine Co., 118th street and Harlem River, New York.



Jonson's Balanced Compound Engine.

American Boiler Manufacturers' Association.

BOILER MAKERS COMBINE FOR THE PURPOSE OF DEFENSE.

A representative body of men—boiler manufacturers—met at the Hotel Anderson, Pittsburgh, Pa., on the morning of Tuesday, April 16, for the purpose of forming an organization, having for its object the remedying of some of the evils that beset those engaged in the business of making boilers, and the removing of some of the dangers to which it is said, with a good deal of truth, the public is exposed through the many inferior and unsafe boilers that are put on the market.

The movement towards this end first found expression in Pittsburgh, amongst the local manufacturers, who, to further the ends aimed at, addressed invitations to other boiler manufacturers in Pennsylvania and adjacent States; those who, from their proximity to Pittsburgh, might be expected to attend the initial meeting of an organization that shall—so its projectors hope—eventually cover every State in the country.

At the first session in the morning there were present about fifty boiler manufacturers, which number was swelled by later arrivals. A temporary organization was effected, and various committees appointed to report at meetings later in the day.

One of these committees—that on permanent organization—made its report at 12 o'clock. They recommended as a name, "The American Boiler Manufacturers' Association," and proposed that the officers should consist of a president, three vice-presidents, a secretary and a treasurer. The committee also made various other suggestions as to membership, provisions for State organization, etc., which will be found embodied in the constitution of the association, this same committee being continued as a committee on constitution and by-laws.

It was necessary to show some reason for the institution of such an association, and this the committee on resolutions did by offering the following, which was accepted after considerable discussion, and some revision by a sub-committee; the resolutions of the committee as revised are here given:

RESOLUTIONS.

Whereas, No business calls for greater care, better material in the construction of its commodity and more exact workmanship than ours; and in view of the fact that so many disastrous explosions have occurred in the past, where materials afterwards tested have been shown to be of an inferior quality; therefore, that we may better secure safety to the lives and the property of every community where boilers are used, be it

Resolved, That we will in all cases use the best material in the construction of boilers, refusing to accept contracts where specifications do not call for material of suitable quality.

Resolved, That it is the sense of this convention that the system of inspection prescribed by the United States Marine Laws should be adopted with but few exceptions.

Resolved, That we recommend all manufacturers of iron and steel boiler plate to make but one brand, which shall have a tensile strength of not less than 55,000 pounds to the square inch, and that the same be stamped with the initial letters found in the name of this association, viz., A. B. M. A., and that this brand be sold to the members of the organization only.

Resolved, That we use all honorable means in influencing our representatives in Congress to procure the passage of such laws as will make it a criminal offense, punishable by fine and imprisonment, to manufacture or sell iron or steel of an inferior quality for boilers, and a similar offense, punishable in like manner, to make boilers, for any purpose, of an inferior quality to those specified by such laws.

Resolved, That we invite all manufacturers of boilers to join our association, knowing as we do that our object is purely philanthropic, and that we are bestowing one of the greatest blessings upon the public at large, who should look with distrust upon any manufacturer who, by reason of personal motives, refuses to take this important step.

The chief change made by the sub-committee had relation to the tensile strength of plates, and to the name by which the material should be designated. The report of the committee previous to revision designated the materials as C. H., No. 1 Flange Iron, and Marine Flange Steel, of a tensile strength of not less than 55,000 pounds, nor more than 65,000 pounds. Strong objections were taken to this by several members, and steel plate manufacturers present by invitation spoke against limiting the tensile strength. Finally, the sub-committee was instructed to confer with steel plate manufacturers, and also to take into consideration the objections of several members to the names of plate adopted. The result was the fixing of a minimum strength only, leaving the rest to be taken care of by the laws governing United States inspection; also, the change in the name of material to that appearing in the report.

In the evening there was a meeting to hear the report of the committee on constitution and by-laws. A few changes were made in this report, which, as adopted, stands as follows:

CONSTITUTION.

ARTICLE I.

Name.—The name of the association shall be the American Boiler Manufacturers' Association.

ARTICLE II.

Its objects are—

1st. To establish such standard for materials and workmanship as will insure uniform excellence of construction of all American boilers, and thus secure safety to the lives and property of all communities where boilers are used, and to procure the passage of laws, making the manufacture, sale or use of inferior materials criminal offenses;

2d. To concert such measures, and take such action as shall be for the interest and advantage of its members, especially,

3d. To procure and furnish to its members statistics of the trade, domestic and foreign, and 4th. To take such action as shall from time to time be deemed advisable regarding the regulation of prices and production.

ARTICLE III.

Membership.—Any firm, corporation, or individual manufacturing boilers, who shall take part in the adoption of this constitution, shall thereby become a member of this association, and thereafter any such manufacturer may become a member, upon application to his State committee in writing, agreeing to be bound by this constitution and paying the initiation fee.

ARTICLE IV.

Officers.—The officers of this association shall be a president, three vice-presidents, a secretary and a treasurer. These officers shall together constitute an executive committee. The duties of said officers shall be such as usually appertain to their offices, and such as shall be set forth, stated, and fixed by the by-laws of this association, or such as may from time to time be imposed upon them by the association.

ARTICLE V.

Assessments.—The expenses of this association shall be met by initiation fees and by assessments levied from time to time, as regulated by the by-laws.

ARTICLE VI.

State Committees.—Each State in which at least three members of this association are located, and in which they employ not less than one hundred (100) boiler makers, shall be entitled to a State committee of not less than three, nor more than five members, who will organize by electing from their number a chairman and a secretary, who shall at once notify the president of the association of such action. Members in such States where there are no State committees may attach themselves to the nearest State committee.

ARTICLE VII.

All questions affecting the boiler trade, or connected with the welfare of this association, shall be submitted to the vote of the association by letter ballot through the State committees by the president on resolution of the executive committee. It shall further be the duty of the president to submit such matters in the same manner on the written request of any five members of the association.

ARTICLE VIII.

Amendments.—Any changes in or amendment to this constitution may be made at any regular meeting of the association, provided at least one month's notice has previously been given by circular to the members—absent members voting by letter ballot, or by letter ballot after like notice, the ballots being canvassed by a majority of the executive committee. A two-thirds vote of the whole association shall be necessary to carry any such change or amendment.

BY-LAWS.

Section I. The officers of the association, after those elected at the time of organization, shall be elected by ballot at the regular meeting, to be held on the first Tuesday in February of each year, and shall hold their respective offices for one year, or until their successors are elected and are ready to enter upon the duties of their respective offices.

Section II. The president shall preside at all meetings of the association, shall be entitled to vote on all questions coming before the Association, and shall perform all other duties incident to the office of president.

Section III. The vice-presidents in the order of their election shall, in the absence of the president, perform the duties of the president, and in the absence of the president and vice-presidents, a president pro tem. shall be elected from the members of the association present.

Section IV. The secretary shall have charge of all papers and memoranda belonging to the association, keep a correct record of all its proceedings, and act as secretary of the executive committee. He shall also communicate to all members of this Association, through the State committee, such action and information relative to meetings, reports, statistics, etc., or other matters affecting the common interest, as he shall be in possession of. He shall also perform such special duties as may be assigned to him by the association, the president or the executive committee. The salary of the secretary shall be two thousand dollars per annum, payable monthly; he shall also be paid his expenses when traveling on the business of the association.

Section V. The treasurer shall receive and have charge of all moneys of the association, shall keep a correct account of the receipts and expenses, and shall present a detailed statement of the same, with the proper vouchers therefor, annually at the meeting in February and whenever called upon by the association. The treasurer will pay out moneys only to order of the president, countersigned by the secretary. The treasurer is to give a bond of $5,000 for the faithful performance of his duties.

Section VI. The initiation fee is to be twenty-five dollars ($25.00). The executive committee may fix assessments from time to time not exceeding twenty dollars ($20.00) in any one year.

Section VII. The executive committee, in the intervals between the meetings of the association, shall have the authority to take such action as they may determine upon in furtherance of the general objects, reporting such action to the next meeting of the association, or by circular through the State committees. They shall also perform such duties as may from time to time be imposed upon them by the association.

Section VIII. Any vacancy in any office, however occurring, shall be filled by the executive committee at their next meeting after the vacancy shall have occurred.

Section IX. The meetings of this association shall be held in various parts of the country; the point for each annual meeting to be chosen at the preceding meeting.

Section X. These by-laws may be altered or amended by a simple majority of those voting by letter ballot, on one month's previous notice by circular.

It was provided that the secretary, or some one to be selected, should receive a salary of $1,000 for six months, while traveling, to induce other manufacturers to join the association.

On the return trip on the Mayflower, the president of the association was instructed to appoint committees on the following subjects, these committees to report at a future meeting of the Association:

On proper specifications for materials and tests of same.

On proper rules for riveting and caulking.

On proper dimensions and construction of manheads and handholes.

On braces and stays.

On methods of attachment of valves, gauges and fittings.

On safety valves.

On uniformity in State boiler inspection laws.

On boiler tubes.

On the rating of boilers by heating surface or otherwise.

Following are the officers of the association for the ensuing year:

President, James Lappan, of Pittsburgh. Vice-Presidents, Philip Rohan, of St. Louis; George Marshall, of Dayton, Ohio; Christopher Cunningham, of Brooklyn, N. Y. Secretary, A. T. Douthett, of Allegheny, Pa. Treasurer, Richard Hammond, of Buffalo, N. Y.

It was concluded to hold another meeting in Pittsburgh, on Oct. 15, and the next regular meeting in New York City, on the first Tuesday of February next.

EXCURSIONS.

The boiler manufacturers who visited Pittsburgh will never find fault with the manner in which they were taken care of. Invitations to visit works of interest were so numerous that it soon became evident that only a few of them could be accepted. Thanks were extended to all, and the matter of entertainment was, in self-defense, placed in the hands of a committee.

In accordance with this committee's recommendations, the members took carriages, provided for the occasion, on the morning of April 17, and visited, first, the steel works of Parks Bros. & Co. Here they were shown how steel plate was made, and also the mysteries of the manufacture of tool and machinery steel. Owing to the limited time, only a brief inspection of these works could be made. One of the members of the firm made the brief stay of the visitors as pleasant as possible, but the time was quite too short to do justice to the works.

After visiting these works the members were escorted on board the steamer Mayflower, which proceeded up the Monongahela river to the works of the National Tube Co., at McKeesport.

To one who has never visited these works a visit will be a genuine surprise. Mr. George R. Riley, consulting mechanical engineer for the works, who had been solicitous for the welfare of the boiler manufacturers, since they reached Pittsburgh, and who accompanied them up the river on the boat, took upon himself the duty of showing the visitors through the works. His task can be better appreciated when it is considered that the buildings cover thirty-five acres of ground, and that nearly six thousand men are employed in the work of making tubes from twenty-four inches to one eighth of an inch in diameter.

The raw material used is pig-iron and iron ore, and to see this material start from the beginning of a train and go through to where it is cut up in lengths for tubes, being, in its progress, scarfed for welding, is of interest to any one who can comprehend mechanical operations. Then to see the operation of bending the material into shape to weld, and finally to see the welding done, over a ball on the end of a mandrel—done so quickly and so surely—is worth a visit to Pittsburgh.

These works (The National Tube Works) are possibly, from a mechanical standpoint, the most complete in their appointments of any works in the country.

Some of the visitors expressed a desire to see one of the twenty-four inch tubes, seven-sixteenths inch metal, tested by internal pressure. Mr. Riley agreed to test one of the many at hand to 750 lbs. pressure, and did test it to 1,000 lbs. pressure.

The tube works were left with a good deal of reluctance. There were many things to be seen; for who could go through thirty-five acres of enclosure in an hour or two?

The next place visited was the steel mills of Carnegie, Phipps & Co., at Homestead. Here the visitors were received by Superintendent Schwab, and shown through what are beyond question amongst the very best steel mills in the world. What strikes the observer for the first time in these mills is the ample room afforded the workmen. No one is crowded; looking through any of the mills there seems to be an amplitude of room that strikes those who have noted the crowded condition of most steel and iron mills, as remarkable. There is room for the observer to go through, witnessing the interesting operations, without the necessity of dodging to the right and left to keep out of the way of the workmen, and of hot forms. Then again, machinery here is brought to such perfection that the labor of the individual workman is reduced to a minimum. He controls the machines that do the work—machines worked by steam and hydraulic pressure.

The best plate is not finished here by continuous rolling; the blooms are first rolled down to definite dimensions, then trimmed, and finally reheated and rolled to dimensions called for. Blooms as heavy as twenty to twenty-five tons are handled in these mills. Altogether, the machinery is excellent, and every known mechanical appliance is used to facilitate the work.

The Superintendent, Mr. Schwab, having referred at the meeting the night previous, to the deceptive form of the Government test pieces, demonstrated what he meant by a test in the testing department of the works. First he had tested a Government specimen that broke at a tensile stress of 65,320 lbs., and 50.3 per cent. reduction of area, then from the same piece, a rectangular section broke at a tensile strain of 53,000 lbs, and a reduction of area of 60.4 per cent.

An excellent dinner was served on the Mayflower, on the way up the river, and on the way home a meeting of the association was held, at which business in relation to the affairs of the association was transacted, votes of thanks passed, and brief speech-making indulged in.

It was proposed at one time during the sessions to recommend a change in the factor of safety from six, as in accordance with United States inspection laws, to five, accompanied, however, by a recommendation of a change in the form of test pieces. The explanation was that the form of test pieces, as provided for United States inspection, gave a tensile strength too high in just about the proportion of six to five. This may be better understood when it is considered that the United States test pieces are formed with rounded corners, while the test pieces recommended were of rectangular section. Every mechanic knows that a rounded corner is an element of strength, hence it was argued that, with the adoption of the proposed form of test pieces, it would, in order to have only an equal factor of safety, be necessary to change that factor from six to five.

This view was that of the steel manufacturers present, especially of Mr. Porter and Mr. Schwab.

This idea was combated upon several grounds, one being that it, at least, looked like going backward in boiler construction, by decreasing rather than increasing the factor of safety.

Another ground was that, owing to the rounded edges formed by the punch or drill, the actual section, as presented in boilers, was very much like that of the section called for in United States test pieces, and hence that it was best to hold to them. Mr. Porter and Mr. Schawb argued their side of the question with much ability, amongst other things affirming that the Government inspectors were ready to ask Congress to make the change, but the motion that the boiler manufacturers recommend such a change was rigorously tabled, where it lies, under other matter so deep as to, in all probability, remain there for some time.

Mr. Porter and Mr. Schwab, who, it should be said, appeared before the association by invitation, accepted their defeat with great good nature, although there is no doubt that the United States section gives plate makers considerable trouble. Probably this will eventually be remedied, but the boiler manufacturers considered, we think wisely, that at the outset it would not be well for them to do anything that could be tortured into an intention to lower the status of boilers in relation to safety. Their efforts, so far, had been in the direction of protecting the public, and no suspicion to the contrary, however unfounded, should rest upon them.

Effecting an organization such as this, in the short space of time devoted to it, is something almost without precedent, hence it may be expected that some changes will be made when the association comes to embrace, as it is expected it will, the entire country. But a foundation has been laid, upon which it is hoped all may stand, widening and modifying the superstructure as may seem best to those who shall further help along the movement by joining forces with those already in the organization.

One of the most pleasing things in relation to the organization was the evident intention to frame everything, even to the fees and dues, so as not to exclude small manufacturers. In fact, the general expression was that it was desirable to bring every reputable boiler manufacturer in the country—no matter whether his business was great or small—into the organization.

One of the most important features of an organization of boiler manufacturers is to bring about an interchange of ideas. Boiler making is not an exact science; in fact, there is no exact science into which the principles of mechanics enter. It is mainly a question of learning from the experience of oneself, and of others. In this respect, it is probable that every boiler manufacturer who attended the meeting at Pittsburgh found himself more than repaid.

An argument adduced in favor of holding a meeting, very soon, in New York City, was that the press of that city would give the effort of the association a boom, as it were. Well, we venture to say that, when the association figures up the extent of the boom which it gets from the "metropolitan" press, it will find itself in a condition of mild astonishment. As a matter of fact, it would be infinitely easier to get press dispatches from some other locality into the New York dailies than it would to get in a reasonably full notice of a local occurrence of a mechanical nature. The American Boiler Manufacturers' Association will, in all probability, find this out, as many another association has done. But there were, fortunately, other considerations than that of the influence of the press for the selection of New York City, and these were weighty enough to make its selection popular.

An Electric Light Plant in Italy.

By Ing. Giovanni Schlegel.

Electric lighting has lately made such progress in this town that your readers may like to hear something of it. The Italian Edison electric light station in Milan (Italy) was started by the Italian Electric Light Co., and is actually the largest plant in Europe. It has all the modern improvements. The building is situated in the center of Milan, and is composed of three large rooms, on three floors, each room of 132.9 feet in length, and 46.8 feet in width. The engines and dynamos are fixed on the first floor (which is 8' 6" below the level of the street). On the second floor the boilers are situated, on the third floor are the stores and laboratory.

The boilers are 9 in number, all made by the Babcock & Wilcox Co., of Glasgow (Scotland). Six of these boilers are connected, so as to form three batteries of two boilers each. Each boiler has 96 tubes, 48.42 square feet grate surface, 1,829.2 feet of heating surface, and develops 160 horse-power at 120 lbs. pressure per square inch. The boilers are fed by Koerting's injectors, and by 5 steam pumps. One steam pump is used to cool the brackets of the dynamos. There are 16 engines driving the dynamos and one small engine driving a fan. Of these engines, 8 Armington & Sims engines and 2 Porter-Allen engines are coupled direct to Edison Jumbo dynamos. The dimensions of Armington & Sims engines are: Diameter of cylinder, 14½"; stroke, 13"; revolutions, 350 per minute. They develop at 120 lbs. pressure per square inch, 135 to 150 horse-power. The dimensions of the Porter-Allen engines are: Diameter of cylinder, 11½"; stroke, 16"; revolutions, 350 per minute. They develop at 120 lbs. pressure per square inch, 135 to 150 horse-power.

Four Armington & Sims engines of smaller size drive each, by means of two leather belts, two Thomson-Houston dynamos (or in all eight). The dimensions of these engines are: Diameter of cylinder, 10½"; stroke, 12"; revolutions, 275 per minute. They develop at 120 lbs. pressure per square inch, 60 horse-power.

Two engines of Ganz & Co., of Buda-Pesth (Hungary), are coupled direct to two alternative current Zipernowsky dynamos, also built by Ganz & Co. The dimensions of these engines are: Diameter of cylinder, 15⅝"; stroke, 17¾"; revolutions 250 per minute. They develop at 120 lbs. pressure per square inch, 150 horse-power.

A separate smaller engine is used to drive a fan for blowing fresh air to the armatures of the dynamos, to cool them when they are developing the utmost power.

The 10 Edison Jumbo dynamos are supplying the Edison incandescent lights, as also Siemens arc lights. The 8 Thomson-Houston dynamos are supplying the arc lights only. The 2 Zipernowsky alternative current dynamos supply, by means of transformers, the incandescent, as also the arc lights on very long distances. The 10 Edison Jumbo, type *C* dynamos give each 800 amperes normal, 900 amperes maximum, and 120 volts at 350 revolutions per minute. The governor of each dynamo has 50 bobbins. These dynamos can be regulated each separately, or all in one time. The 8 Thomson-Houston dynamos supply each 35 arc lights of 10 amperes and 1,750 volts at 850 revolutions per minute. The 2 Zipernowsky alternative current dynamos give each 36–40 amperes and 2,000 volts at 250 revolutions per minute. The continuous current necessary for the excitation of the electro-magnets is furnished by Edison dynamos. The electro-motive force is kept constant by means of a compensator; there is also a mercury governor, of the Blathy type.

The successful working of the plant is largely due to Mr. S. W. Lieb, the superintendent, formerly of New York.

It is evident from the patents issuing, that there is no decrease of interest in England in mechanical stokers. Why is there not greater interest on the subject in this country?

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Railway Relief Associations.

A correspondent of *The Century*, Mr. L. O. Goddard, in an "open letter" addressed to that magazine upon the subject of "Railway Relief Associations," starts out by the astounding statement that "Permanence in his position and probability of promotion are what the railroad employe is now virtually guaranteed," and then he goes on to say that, "Were he equally as well assured of assistance during sickness, disablement, or superannuation, and for his family at his death, his condition as a wage-earner could not be improved." And yet, somehow, we are continually seeing evidence, either that railroad employes are not virtually guaranteed permanent employment, or that—what will be conceded to be much the same thing—the guarantee, if there be any, fails in very many instances to guarantee anything. We feel bound to say that, as a result of some little observation and experience, we have been led to the conclusion that railroad employes have about the same guarantee of permanent employment that other workmen possessing equal skill have, and about the same probability of promotion. And that something more than relief associations is needed to place their condition beyond the possibility of improvement, we think is proven by the very argument presented for the necessity for the organization of such associations, managed by the companies for the benefit of their employes. It seems to us that railroad employes are very much the same by nature as other men, and that, until they are so situated that the returns for their labor afford them a good living, and enable them to manage their own affairs for the protection of themselves and families in case of sickness, disability or death, their condition cannot be said to be beyond the possibility of improvement.

Some of the railway relief associations seem to have worked fairly well, while others have not worked at all well, and it may well be doubted if the ultimate effect of such associations is ever beneficial, upon the whole, where the element of coercion enters into the scheme, and men are compelled to join and pay a fixed amount upon condition of employment, no matter what other arrangements of their own they may have, or whether or not their judgment approves of the association.

Railroad men, and, in fact, all men, prefer to manage their own affairs in their own way, and they should be allowed to do so, so long as they do not interfere with others' rights to do the same thing. A former editor of *The Century*, the late Dr. J. G. Holland, once wrote:

It seems to me, either that there is a great deal of human nature in a pig, or that there is a great deal of pig in human nature. I find myself always sympathizing with a pig that wishes to go in an opposite direction to that in which its owner would drive it. It would be a sufficient reason for me to desire to go eastward, that a man was behind me with an oath in his mouth and a very heavy boot on his foot, endeavoring to drive me westward. We are jealous of our freedom. We naturally rise in opposition to a will that undertakes to command our movements. This is not the result of education at all; it is pure human nature.

And it seems as though there is a continuous and fatal tendency to forget that pure human nature in railroad employes or other workmen is precisely the same as pure human nature in other people, and that it is the human nature which Abraham Lincoln declared "you cannot repeal."

Mr. Goddard gives high praise to the relief association of the B. & O. road, and holds it up as an example for other roads to follow, but admits that "the compulsory feature looks to an outsider like a hardship, but the obligation is on him only who seeks employment." Thus we see that an obligation which is admitted to be a hardship, when accepted by the seeker for employment, puts his condition as a wage-worker beyond the possibility of improvement. Queer logic, that! And now the Legislature of Maryland, having annulled the charter of this association on account of this compulsory feature, the company proposes to run it without a charter, and, according to the press reports, also proposes to retain the compulsory feature by the simple expedient of discharging those who refuse to join (notwithstanding Mr. Goddard's guarantee of permanent employment), and that there is likely to be a strike over the entire road in consequence.

Give the Street Railways a Chance.

Just what the objection is to permitting the street car companies in New York to substitute cable traction for horses is not clear. To be sure, there will be some tearing up of streets in making the change, but there is tearing up of streets for other purposes, and if there is to be any progress in the way of living and doing business, this cannot be avoided. Moving street cars by horses is antiquated and unmechanical, and the companies should be allowed to change to any other system, the features of which are unobjectionable. This may be cable traction, electricity, or steam direct. But whichever is best for any given locality must be determined mainly by experiment, and the roads should be free—within reasonable limits—to make the necessary experiments.

There is in most large cities, but notably in New York, a disposition to hamper the railways; this is born, in many instances, of a purpose on the part of the companies to take too much; but it is no reason why, out of spite, so to speak, they should be prevented from doing something that would directly benefit the citizens. Give the companies a chance to put something mechanical in the place of the horse; the public requires it quite as much as the roads.

Important if True.

If it is true that the five Central American States are to form such a union as is reported, it will have an important effect upon trade. So far, it appears they have entered into a compact insuring perpetual peace, provision having been made for submitting all differences that may arise to arbitration, the nations that may act as arbitrators being named. Other work has been done in the direction of complete union, which it is believed will soon be accomplished. The agreement upon arbitration is a step in civilization in advance of the more pretentious nations. The people of these States can now more fully devote themselves to the useful arts, and having no occasion to arm against each other, will have but little use for armies. Their commerce will increase, and their demand for the manufacture of other countries will correspondingly grow. Closer commercial relations with these States on the part of the United States would be of mutual benefit.

Now that the courts have decided that the New York City government has a right to insist that all electric wires shall be removed from the poles and placed under ground, it will probably be found that there is nothing very serious in the way of putting them there. Two things have been in the way of doing this all along. One was that the commission to provide for burying the wires was a political instead of an expert one, and the other that the large companies controlling the wires made up their minds that they could defy the city in the matter. While the companies are blamable in that they—some of them—determined to keep their wires where they were, the city is also to blame for not placing its part of the business in the hands of the most competent men to be found. The companies have justice on their side in the complaint that there has been very poor engineering talent displayed in providing for the accommodation of the wires. It is safe to say that, had an individual undertaken the city's part of the work, he would have paid a good deal better salaries and would have done the job at one-quarter the cost. But the man with a "pull" would have been left in the cold.

There is burning need of a post-office stamp with which the average post office clerk can stamp an envelope legibly. It is generally impossible the way the stamping is now done, to determine from the envelope whether a letter comes from Alaska or California, and it would sometimes be—for example when the writer fails to give any evidence of his location—a matter of considerable importance to be able to decipher the daub that is applied at the post-office. The man who will invent a stamp that will do its work so that it shall be legible will "fill a long felt want." If it should be found that the fault is in the clerk, then the inventor should turn his attention towards inventing an automaton to do the stamping. There is a good opening for business in one or the other.

Questions and Answers

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(178) B. B. L., Bristol, Conn., asks: What has been the heaviest blow struck by the largest hammer made? Also, what is the length and diameter of the largest boiler made? *A.*—We do not keep a record of the size of machinery, and therefore cannot answer your questions.

(179) W. N., Laconia, N. H., asks: Which will weigh the most, one cubic inch of small shot or one cubic inch of large shot? Both kinds are supposed to be closely packed. *A.*—A cubic inch of the small shot will weigh the most, provided both kinds of shot have the same density.

(180) C. S., Petrolia, Ont., asks: A 10-inch flue, 14 feet long, is placed under a 16-foot boiler, one-half of this flue is exposed to the fire (an oil burner), the purpose of this flue is to heat the feed water which flows through it. Will there be any saving of fuel with this arrangement? *A.*—In some cases it may be conducive to an economy of fuel, as it will increase the heating surface. If there is no other way of heating the feed water this arrangement will also add to the life of the boiler, as cold water is liable to injure it.

(181) A. K., San Francisco, Cal., writes: We have an upright automatic steam engine, which we wish to balance. I wish to place the counterbalance directly on the crank, but another party claims that it is just as well to place it on the fly-wheel. I claim that this is not the place for it. Please give your opinion. *A.*—Do not, under any circumstances, place the counterbalance on the fly-wheel, as it will throw the fly out of balance, and will have a tendency to burst it, and may be the cause of some fatal accident. It will also unnecessarily increase the strain on the crank shaft and its bearings, and may result in permanent injury to the engine. The proper place for the counterbalance is in the crank disk.

(182) P. L., Worcester, Mass., writes: Suppose that in a four-wheeled wagon (wheels 3 feet diameter) there is placed a weight of 100 pounds directly over the center of each axle, will it require more power to move this wagon than when the same weights are placed in the center of wagon? *A.*—No; the same amount of power will be required in each case to move the wagon. 2. Suppose that both weights are placed directly over the center of one axle, will it require more power to move the wagon; and if so, why? *A.*—In all these cases it will require the same amount of power to move the wagon. If the weights are excessive, so that the wheel, with all the weights concentrated over one axle, will sink into the ground double the distance they will do with the weights distributed over the axles, then it will require more power in the last case to move the wagon.

(183) R. F., Jersey City, N. J., asks: 1. Can you give me a rule for calculating the strength of ropes (safe working load and proof strain)? *A.*—For ropes up to six inches in circumference: Square the circumference and multiply by 800; the result will be weight required to break the rope. The proportion of the weight which can be safely put upon it for a working load will depend upon circumstances, and may be from one-twentieth to one-tenth. You will find the subject more fully treated in the engineers' pocket books—Haswell, Nystrom, Trautwine and Molesworth. A full treatment requires the use of tables which we have not room for here. Ropes are usually designated in making calculation for strength by their circumference. 2. What power is gained by pulley blocks? *A.*—Theoretically, the *force* gained is equal to the power applied, multiplied by the number of times the rope passes from one block to the other. You will find this explained in the answer to Question 529, issue of Dec. 8, 1888. 3. What is the greatest weight that rope and pulley-blocks are generally used for, and the largest diameter of pulley? *A.*—We cannot say, but you can ascertain by inquiring of dealers in your city.

(184) C. C. G., Orange, Mass., asks: What is the object of so many melters in charging

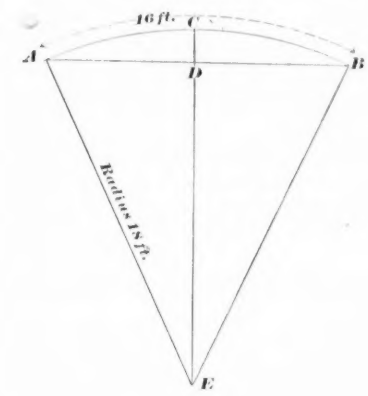
their cupola from one to two hours before putting on the blast? According to some authorities the time varies from 5 minutes to 2 hours 45 minutes between charging and putting on the blast. In answer to my inquiries of different persons, one man said the object was to rest; another said the iron would be softer. Is there any advantage gained by charging an hour before putting on the blast? *A.*—We referred this question to Mr. L. C. Jewett, who replies as follows: In our judgment, there is no benefit derived from toasting or roasting the iron, as it would not get very hot in say two or three hours, not enough to anneal it, and not enough to affect the resultant cast. The proper time to put on the stock to bed in a cupola is when the fire is well burned through. Now the time to have the bed burned through is as near as possible to the time it will necessarily take to charge up furnace and then put on the wind. As a matter of fact, this point is quite variable, depending on the weather, conditions of the atmosphere and kindling wood, quality of the coal, quick or slow igniting, etc. There are melters who, "to be sure to be there," as the saying is, start the fire as soon as they can get it ready and charge right on, in order, as your correspondent says, to have a rest. The best practice is to so time the lighting of the fire that charging can be just completed when it is time to put on the blast.

(185) **A. K. W., Peekskill, N. Y.,** writes: Will you please inform me how much power it takes to run a train of wheels arranged like sketch. I wish to have the pinion marked 3 run about the same number of revolutions as the knives in a wood planer, which I think is about 4,000 per minute. The three large gears are intended to be 10 inches diameter, pinions 2½ inches diameter; what number of teeth will be right for such gears? Will it require more than one man's power to run it, and on which shaft would a fly-wheel be of service? *A.*—You do not state the resistance which the last pinion, marked 3, has to overcome. The number of teeth will depend upon their required strength, and this again will depend upon the resistance to be overcome, or the amount of work to be performed. The fly-wheel should always be as near as possible to the application of the power. 2. I also wish to know how many feet per minute steel, cast-iron, and brass should run for turning and boring? *A.*—The speed of cutting tools is limited by the heat produced by their action, and this heat must never be so great as to affect the temper of the steel. Hence it is less, the harder the material of the work. White cast-iron is usually cut at a speed of about 5 feet a minute; steel and grey cast-iron, 10 to 20 feet; wrought-iron, 18 to 25 feet; brass, 50 to 100 feet; and wood from 3,000 to 10,000 feet a minute. These speeds have been taken from Spon's Dictionary of Engineering, and will serve, in a general way, as a basis for calculation; but for certain kinds of work and quality of material they may have to be modified. A knowledge of the proper speeds for all kinds of work can only be gained by experience. For boring, the speeds should be reduced about 30 per cent.

(186) **W. E. A., Philadelphia, Pa.,** sends us a sketch of two horizontal boilers, standing in line lengthwise. The ends of these boilers are connected by a horizontal steam pipe, and from the center of this pipe a vertical pipe leads the steam into another horizontal pipe. One end of this pipe leads the steam into one dye-house, *A*, and the opposite end of the same pipe leads the steam into another dye-house, *B*. In regard to these boilers and pipe connections he writes: These boilers have to supply steam for dyeing and finishing cloth, etc. I have considerable trouble in keeping anything near a steady pressure in the boilers. If, for instance, steam is drawn for the purpose of boiling material in the kettles, the steam in the boilers runs down from 70 to 30 pounds, in spite of all I can do, and when it reaches 30 pounds we can hold it. Again, when they are drawing steam in both dye-houses at once, and take as much steam as they can possibly get, the dye-house *A* will rob dye-house *B* to a great extent. Now the questions I wish to ask are these: 1. Will the pressure in the dye-houses be equalized by putting a reducing valve at each end of the main steam pipe, and also increasing the diameter of the steam pipe in dye-house *B* from 4 to 5 inches? *A.*—Putting a reducing valve at each end of the main pipe will help to equalize the steam pressure in the dye-houses; but whether an increase of the diameter of the steam pipe in dye-house *B* will do any good will depend on the sum of the areas of the openings from which steam is drawn. 2. Would there be any economy in the idea, if it is practical? *A.*—Economy will be promoted so long as the new arrangement will prevent a waste of steam in the dye-houses. 3. Would it make much difference in the time of boiling the kettles? *A.*—With your present boiler capacity it will probably not make any difference. 4. Why is it that I can hold the pressure when it reaches 30 pounds? *A.*—Because the boiler capacity is insufficient for furnishing steam at a greater pressure.

(187) **H. H., Indianapolis, Ind., writes:** Myself and partner propose to build a steam carriage to run on ordinary roads. It is to have two driving wheels 2½ feet diameter, and one leading wheel; one cylinder, 2½ inches diameter, stroke 3 inches. Boiler 18 inches long, eight inches diameter, made of gas pipe, capped on both ends; it is to have 32 flues, ⅛ inch diameter, besides the fire-box, which extends to the water line, or to a little below it. We intend to use gasoline for fuel. What we want to know is, do you think the engine is large enough to run the carriage at an average rate of eight miles an hour? total weight will probably not exceed 400 pounds? *A.*—Yes, provided the roads are nearly level, and not too rough. 2. Is the boiler, as per enclosed sketch, large enough to keep up a pressure of 50 pounds per square inch? *A.*—No; in fact, the boiler will be of no service; the flues are too small in diameter; they should not be less than 1 inch diameter—1¼ inch will be better; and otherwise the construction of the boiler is very bad; it will not make steam sufficient for any practical purposes. 3. My partner thinks that there is no need of an opening for the escape of smoke that may arise from the gasoline; I think there should be. What is your opinion? *A.*—If we understand correctly, your partner means to say that there is no need of a chimney. It must be self-evident that, without a chimney, or some opening for the escape of the products of combustion, a proper supply of air necessary for combustion cannot be maintained; you will need a chimney or some kind of opening in the top of boiler for the escape of the products of combustion and to give the necessary draft. 4. Do you know of a better method of connecting the engine to the axle, as shown by the sketch of the train of gearing? *A.*—We have not sufficient data to judge correctly; we do not see anything wrong in your method of gearing.

(188) **J. H., Cincinnati, Ohio, writes:** I work at gas-holder making, and as most of us are poor hands in geometry, many of us get stuck in the following problem, of which I have sent you a sketch. The length of the arc *A C B* and its radius are given. It is required to find the length of the chord *A B*, and the height *C D*, of the arc. Our rule of thumb will not reach it, and I have never seen it explained in the American Machinist. *A.*—The first step will be to find the number of degrees in the angle *A E B*, that is, the angle formed by the radii drawn through the extremities *A B* of the arc. The circumference of a circle, described with a radius of 18 feet, is equal to $2 \times 18 \times 3.1416 = 113.09+$ feet. This circumference represents 360 degrees, and, therefore, the number of degrees in an angle subtended by an arc 16 feet long, are found by multiplying 360 degrees by the length of the arc, and dividing the product by the circumference; hence we have $\frac{360 \times 16}{113.09} = 50.93$ degrees. For the sake of simplicity, say 51°. The line *C E* bisects this angle; hence the angle *A E C* will contain $\frac{51}{2} = 25$ degrees and 30 minutes. Looking for the sine of an angle 25°, 30′ in a table of Natural Sines and Tangents to a radius 1 (a table of this kind can be found in any good engineer's pocket book), we find the sine to be equal to .4305111. Multiplying this sine by the radius, we obtain the length of *A D*; that is, one-half the chord. Thus $.4305111 \times 18 = 7.7491+$, say 7¾ feet; and the length of the chord *A B* will be $7¾ \times 2 = 15½$ feet. To find the height *C D* we subtract the length of *D E* from the radius. The length of *D E* is found by subtracting the square of *A D* from the square of the radius, and extracting the square root from the remainder; thus,



$$\sqrt{(18 \times 18) - (7.75 \times 7.75)} = \sqrt{.324} = 60.06$$

= 16.24 feet. Therefore, *D C* will be 18 — 16.24 = 1.76 foot.

(189) **J. W. K., Granger, Tex.,** writes: I know that 15 square feet of heating surface is generally allowed for one-horse power; but I am not quite certain of the surface which should be classed with the heating surface. For instance, do you count the bottom surface of a horizontal tubular boiler along which the fire passes, the end where it returns, as well as the flue surface? Or do you count the flues alone? *A.*—All the surfaces which you have mentioned belong to the heating surface. In general, it may be said that all surfaces which transmit heat to the water and steam are classed with the heating surface. In rating the horse-power of return tubular and flue boilers, the general practice is to count as heating surface ⅗ of the shell, the outer surface of the tubes, and the area of the back head minus the surface cut out for the flues. It should also be understood that 15 square feet of heating surface for one horse-power is not always required, as this depends on the kind of engine which the boiler supplies with steam; consequently many steam engine builders will allow only 12 square feet of heating surface per horse-power; others, 10 square feet; and sometimes even as low as 7 square feet per horse-power is allowed. When the class of engine which the boiler has to supply with steam is not known, the safest practice is to allow 15 square feet of heating surface per horse-power. 2. How many square inches of heating surface are there in one foot of a flue, 3 inches diameter? *A.*—Multiply the circumference in inches of the flue by 12, thus: The circumference of the flue is 9.42 inches, and $9.42 \times 12 = 113.04$ square inches, which is the heating surface in one foot of a 3-inch flue. 3. My engine cylinder is 8 inches diameter and 15 inches stroke. I want to know how to calculate the power of it and other engines by their measurement. *A.*—You cannot compute the horse-power of an engine without knowing the steam pressure and number of revolutions. The rule for finding the horse-power of an engine has been given in answer to Question 305, in our issue of June 23, 1888.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue

Gear wheels and g-cutting. Grant, see adv., p. 16.
Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.
$100 Reward, page 14.
$100 Reward, page 14.
$100 Reward, page 14.
Shafting Straighteners. J. H. Wells, Tampa, Fla.
Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.
Duplex Gear Cutters. R. M. Clough, Meriden, Ct.
20″ Upright Drills. J. E. Snyder, Worcester, Mass.
23″ Upright Drills. J. E. Snyder, Worcester, Mass.
25″ Upright Drills. J. E. Snyder, Worcester, Mass.
28″ Upright Drills. J. E. Snyder, Worcester, Mass.
"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.
The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.
Berryman Feed-Water Heater and Purifier. Benj. F. Kelley, 91 Liberty street, New York.
R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.
Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.
Machine Screw Taps of all sizes and threads, manufactured by S. W. Card & Co., Mansfield, Mass.
"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.
Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.
"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.
Fire Brick and Clay Retorts; large variety; special shapes to order. Borgner & O'Brien, Philadelphia.
Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.
Best silk wiping towels for machinery in the market. S. A. Smith, 23 S. Canal st., Chicago, Ill.
Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.
For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.
Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illustrated. Frasse & Co., 92 Park Row, New York.
For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves, T. Kieley, 11 W. 13th st., N.Y. Send for des'n.
See Illustration of Portable Key-Seating Machine in April 4 issue. For further particulars address T. C. Dill Mach. Co., 726 Girard av., Philadelphia, Pa.
Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See April 4, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.
Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.
W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.
Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.
Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2.00. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.
Patterson, Jordan & Gottfried, 146-150 Centre st., N. Y. Metals, Machinery, Hardware, Tools and Supplies for Machinists, Mills, Engineers, Brass Goods Mfrs., Factories, etc. An extensive assortment of Bolts, Screws, Wire, Taps, Drills, etc., carried in stock.
The International Boiler Co., Limited (Allan Stirling, M. E., president,) manufacture the safest, most economical, compact and durable water tube boilers. All wrought metal. Large mud drum. Perfect circulation. By unscrewing only three bolts, access is gained to every part of the boiler. Dry steam and great economy of fuel guaranteed. Office, 74 Cortlandt street, New York.
"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor place, New York.
"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Pub'g Co., 96 Fulton st., New York.
"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the American Machinist, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including April 25, 1889 issue, 75 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.
"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the American Machinist, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 89 articles have thus far appeared up to and including the April 18, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

Manufactures

W. M. Towers will build a steam ginnery at Rome, Ga.

The Farmers' Alliance propose to build a cotton mill at Bennettsville, S. C.

McLemore & Bro. will build a flour mill and elevator at Columbia, Tenn.

The Whitin Machine Works, Whitinsville, Mass., are to enlarge their works.

The contract has been let for rebuilding the Reading Silk Mill, Reading, Pa.

The Lenoir Furniture Co. will build a furniture and chair factory at Lenoir, N. C.

It is expected that the Atlantic & Danville Railroad will build shops at Danville, Va.

The Stark cotton mill corporation, Manchester, N. H., has commenced building a mill 165x420 feet.

The Standard Machine Company, Mystic, Conn., will put up new brick shops to replace its wooden ones.

R. B. Baer is interested in a company that expects to build a large foundry and machine shop at Houston, Texas.

Brunner & Duncan have rebuilt their shops and foundry at Alton, Ill., and will continue their work of building mining cars.

The North Alabama Lumber & Wood-Working Co. will build a saw mill and probably a wood-working factory at Fort Payne, Ala.

The Gibson-Hilliard Manufacturing Co. has been organized, to manufacture all kinds of woodgn turned goods at Florence, Ala.

A Boston syndicate has purchased 30,000 acres of timber and ore lands, and intend building a large wood-working factory at Gadsden, Ala.

N. H. Richardson & Sons, of Lancaster, N. H., are to build a two-story addition, 60x35 feet, to their furniture factory, and put in steam power.

Charles Richardson & Sons, proprietors of Edge Hill Iron Furnace at Edge Hill, Pa., contemplate moving a part of their plant to some point in the South.

The Center Furnace Company, Bellefonte, Pa., has increased its capital stock to $150,000, and it is understood will add a rolling mill to its present furnace plant.

Ground was broken this week for the works of the Union Drawn Steel Company, at Beaver Falls, Pa. The capital stock is $1,000,000, much of which is held by Pittsburgh parties.

The Crescent Manufacturing Company, Cleveland, Ohio, send us a catalogue of their specialties. The company make flue cleaners and scrapers, tube cutters and expanders, grease cups, belt clamps and fasteners, hack saws, etc.

The Standard Oil Company have commenced work on their new boiler works, which are located at Lima, Ohio. The boiler shop will be utilized in manufacturing new boilers, making plates for iron tanks and repairing old boilers.

The Huntsville (Ala.) Gas Light Co. will consider the increasing of the capital stock $35,000 and the issuance of bonds to the amount of $50,000 to enlarge and improve their works. A holder with capacity for 70,000 feet of gas will be built.

The furnaces of the Reading (Pa.) Iron Company are still in operation, working up the materials on hand, and it is likely that several other departments of the works will be at once placed in operation if the creditors arrive at an understanding.

Fay & Scott, of Dexter, Me., write that they are driven with orders in their line (machine tools), and that, among other special tools, they are at present building a 66-inch gap wood turning lathe for patterns, which will weigh about 2½ tons.

There is water-works agitation at Anniston, Ala.; Birmingham, Ala; Fort Payne, Ala.; Elberton, Ga.; Georgetown, Ky.; Winchester, Ky.; Avoca, N. Y.; Cleburne, Texas; Steelton, Pa.; Saginaw, Mich.; Seattle, W. T.; Shelbyville, Tenn.; Denver, Col.; South Framingham, Mass.; Marcelina, Mo.; Southampton, L. I.

The Chattanooga Plow Company, Chattanooga, Tenn., have just finished improvements and additions to their building at a cost of $5,000. The operating force of laborers has been increased to 150, and the capacity of the works increased 50 per cent. Improvements are contemplated which will give employment to 200. The present capacity of the works is 20,000 plows, 200,000 plow points, 2,000 cane mills and 1,000 evaporators per annum.

At the last meeting of the Beverly (Mass.) Board of Trade, preliminary action towards forming a building association was taken. It is proposed to form an association of $50,000 capital for the purpose of erecting manufacturing buildings, to rent at a low rate of interest, and thoroughly equipped with all modern facilities, shares to be placed at from $25 to $50 each. The plan is to construct four such buildings on Rantoul street. Thomas D. Lovett gave the scheme a start by offering to take stock to the extent of $8,000, others also offer to subscribe liberally. The following committee was appointed to consider the matter and report at an adjourned meeting next Monday: George P. Brown, Robert G. Bennett, S. W. Winslow, Charles H. Kilham, George Swan, Samuel Cole, Samuel H. Stone, George C. Stickney.—*Commercial Bulletin.*

Machinists' Supplies and Iron.

New York, April 20, 1889.

Iron—American Pig.—Though quotations are not lower, there are indications that actual sales are at lower prices. We quote No. 1 X Foundry, $17 to $18; No. 2 X Foundry, $16 to $17; and Grey Forge, $15 to $15.50.

Scotch Pig.—We quote Coltness, $21.50 to $21.75; Gartsherrie, $20; Summerlee, $21 to $21.50; Eglinton, $19 to $19.25; Dalmellington, $19.75 to $20; Clyde, $20.50; and Langloan, $20.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 90 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted - See bottom of third column, page 11.

A 1 draftsman. Who wants him? Address A., care American Machinist.

Wanted—Position by a first-class mech'l draftsman; 16 years' experience. Box 91, Am. Machinist.

Mechanical engineer wishes opportunity to travel for manufacturer. Salesman, American Machinist.

Wanted—A first-class lathe hand with $1,000. A good salary will be paid to a first-class man. Address Box 90, American Machinist.

A young mech. engineer, good draftsman and calculator, is open for engagement. Steam eng'g preferred. First-class refs. Address "185," Am. Mach.

Wanted—Pattern maker; one who thoroughly understands the making of patterns for iron pipe, fittings, valves, cocks, etc. The Kelly & Jones Company, Greensburg, Pa.

Wanted—A first-class moulder, competent to superintend a foundry. Must have $5,000; a good salary will be paid to a first-class man. Address Box 78, American Machinist.

Wanted—Two machinists and tool makers, used to metal working, dies, automatic machinery and general mill work. Steady job for the right men. C. & M., 234 W. 29th st., N. Y.

Wanted—A draftsman and designer to take charge of a drawing room for shop employing 50 hands. State salary desired, age and experience. Address "A. Mfg. Co.," care Letter Carrier 44, Cincinnati, O.

Wanted—Superintendent to take charge of a wood-working machinery manufactory; must be versed in designing, pattern making, and understand the handling of men. Address Indiana Machine Works, Fort Wayne, Ind.

Wanted—Situation as foreman or supt. of boiler shop by man of experience on marine portable and stationary boilers; can estimate correctly and make own drawings if necessary. 34 years of age. First-class references. Boiler Maker, Am. Machinist.

A young man with seven years' experience in the designing and construction of presses and tools for sheet metal working, now occupying a position of designer, desires a change in order to extend his knowledge. "P. D. Q.," American Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none; price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Steel Name Stamps, Copper Burning Brands, etc. W. G. Sackmann, 1099 First av., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Machine shop and foundry for sale. A splendid opening. One thousand dollar job to start on. Address 615, American Machinist.

Parties wishing to exchange their old gear cutters for full automatic machines, address, giving description, "Trade," American Machinist.

For sale, cheap, 32-inch Prentice Bros. Back-Geared Power Feed Drill Press, new. Price, $250. Address Standard M'f'g Co., Moore's Hill, Ind.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Thos. Ordish, 1723 S. 7th st., Phila., Pa.

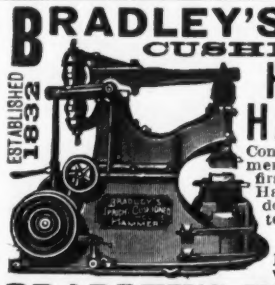
Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Boilers—The proprietors of a large engine works in Alabama desire to connect a large boiler works with their plant, and are desirous of finding a suitable party with necessary machinery and capital to operate such a plant. Box 80, Am. Machinist.

For Sale—Mfg. and jobbing machine business, established over 5 years. All modern tools in best of shape; easily work six hands; will bear investigating; $800 worth of work now ready if taken at once, satisfactory reason for selling. Price, $3,000. H P. Norton, Brockton, Mass.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



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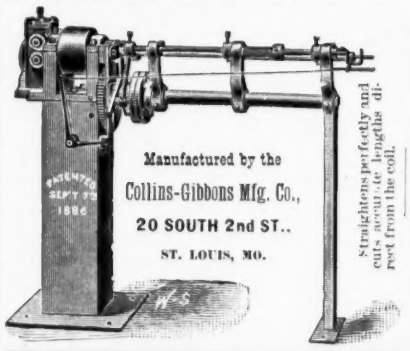
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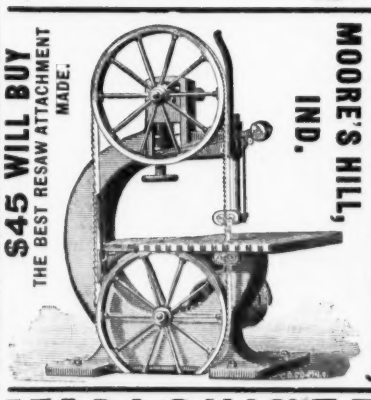

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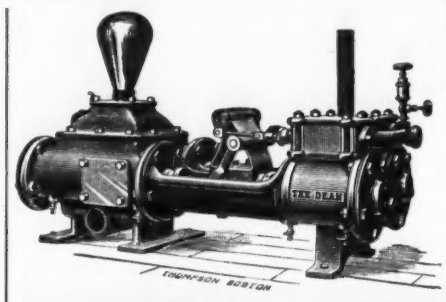

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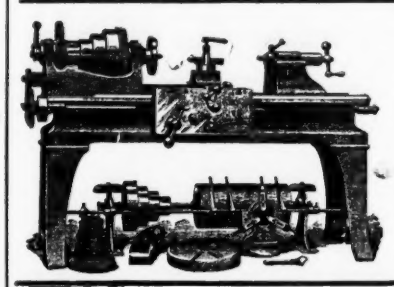

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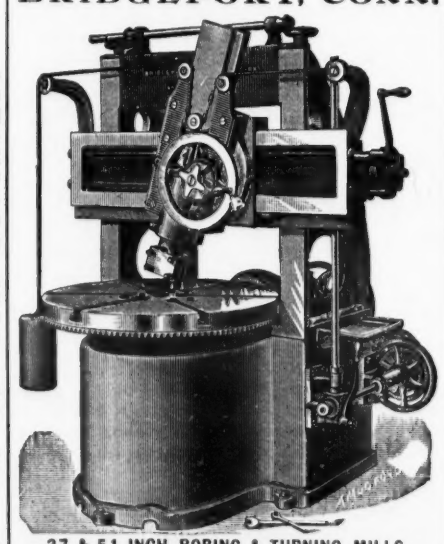

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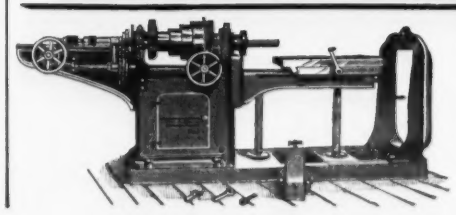

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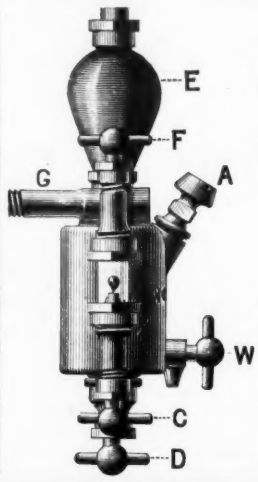

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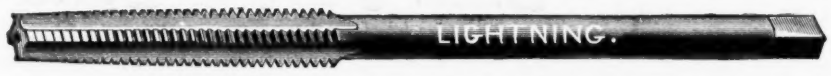

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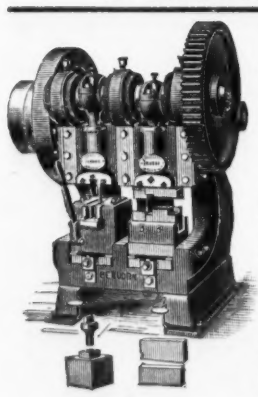

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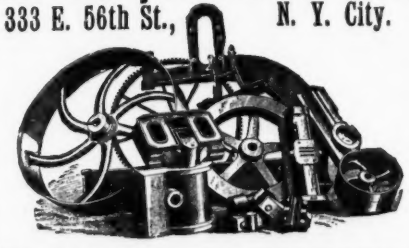

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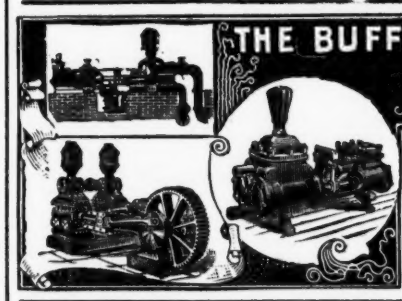

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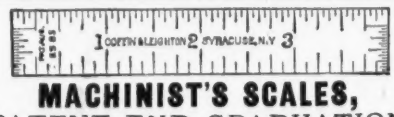

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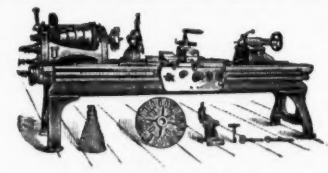

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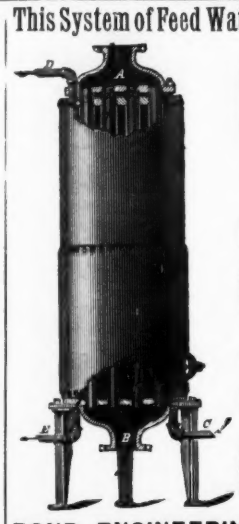

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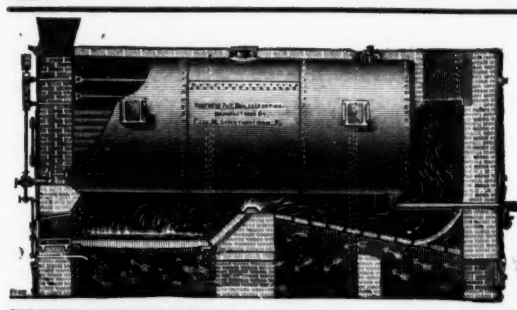

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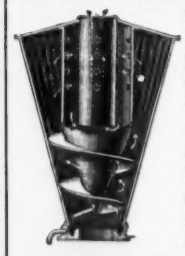

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30 in.	36 in.
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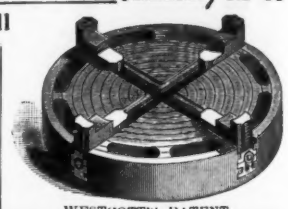

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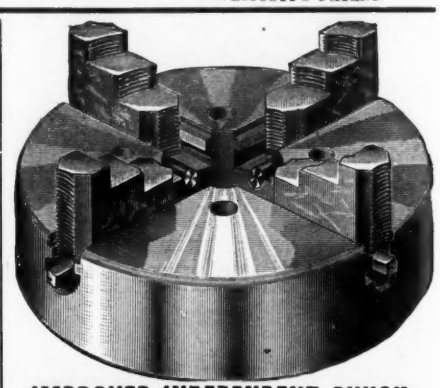

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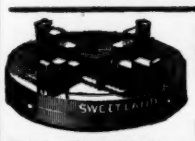

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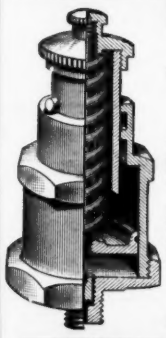

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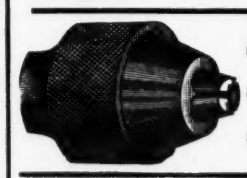

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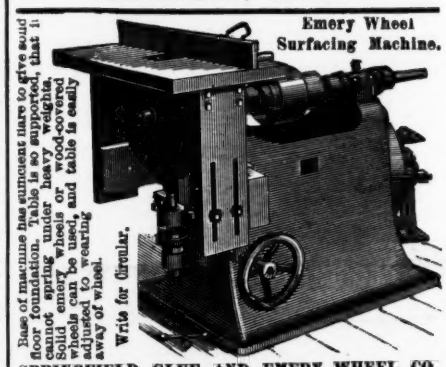

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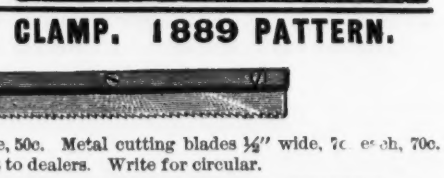

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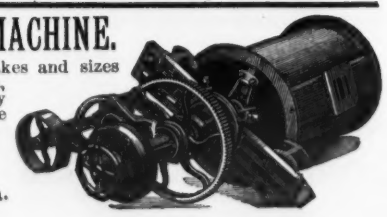

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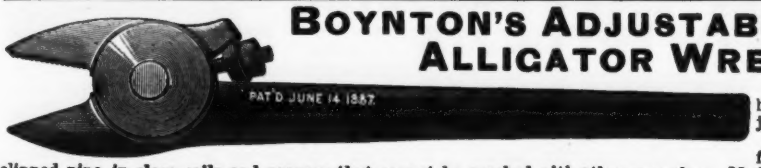

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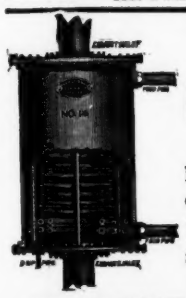

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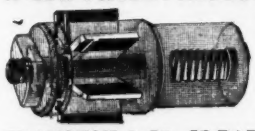

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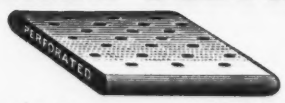

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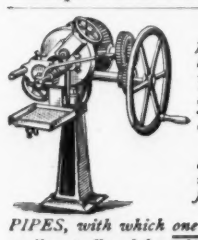

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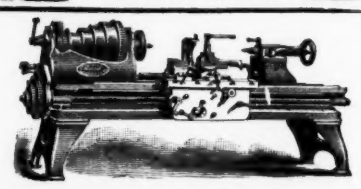

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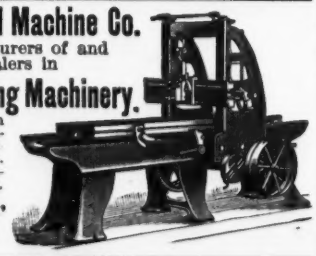

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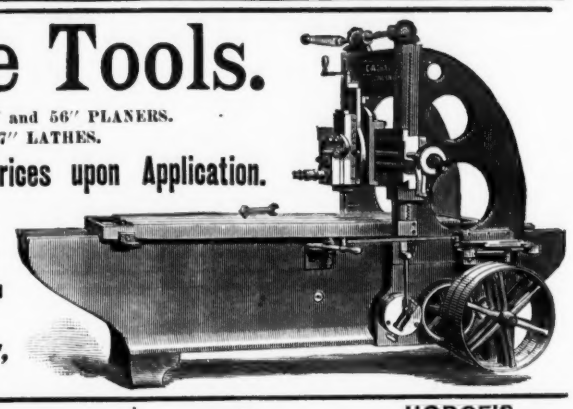

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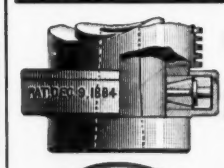

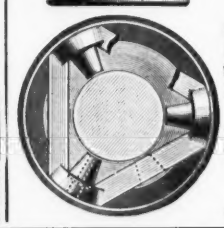

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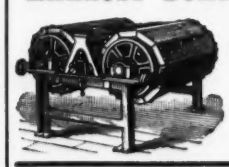

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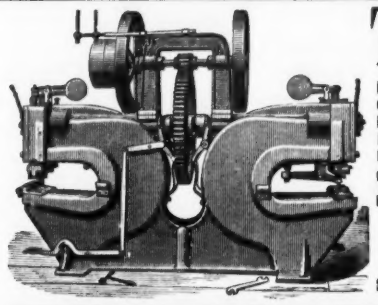

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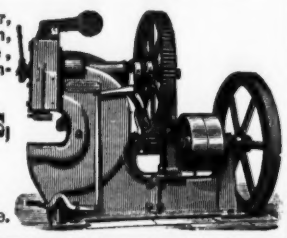

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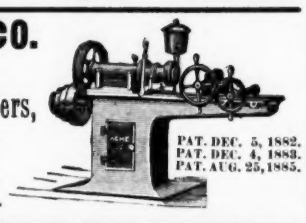

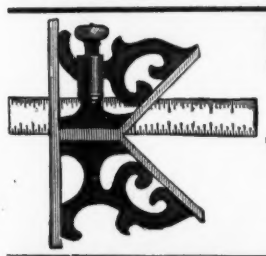

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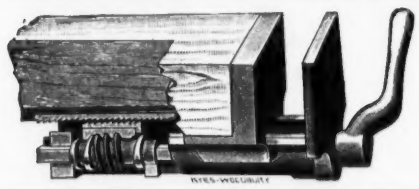

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The money has been deposited with the AMERICAN MACHINIST, and will be remitted by them upon our order to the successful competitor decided upon by us, whose name will be published by us in this space Sept. 5th, 1889 issue.

Drawings must be submitted to us on or before **August 15th.**

LODGE, DAVIS & CO.,
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☞ See Advertisements, pages 15 and 16.

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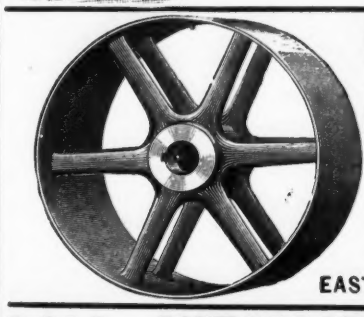

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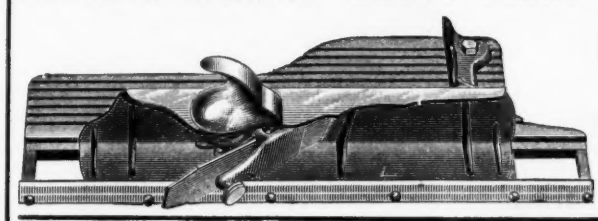

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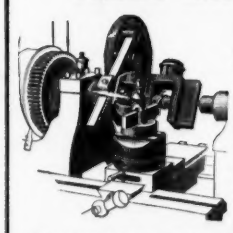

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Can attach machine to or remove it from any ordinary engine lathe in five minutes.
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Above features guaranteed.
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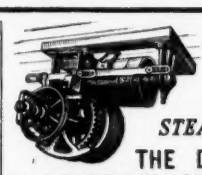

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NO BOILER. NO COAL. NO ENGINEER.
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DURABLE, RELIABLE, SAFE and ECONOMICAL.
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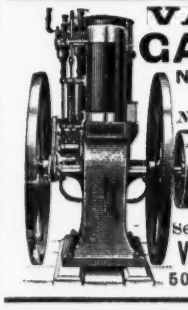

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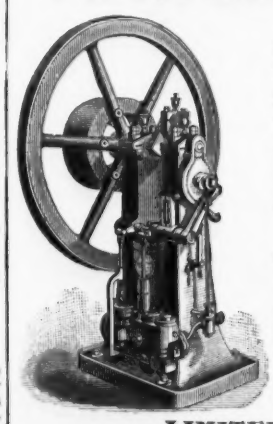

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OVER 125 IN USE IN N. Y. CITY.
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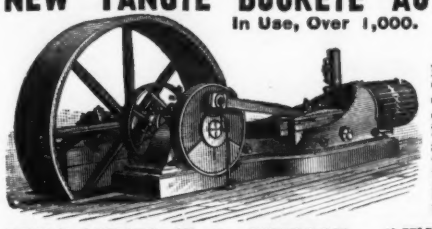
In Use, Over 1,000. 25 to 1,000 H. P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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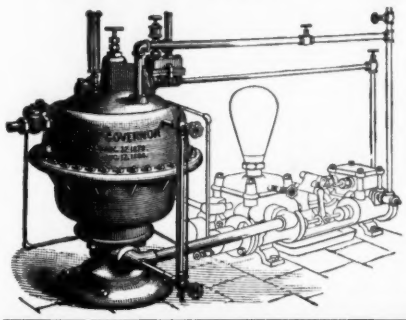

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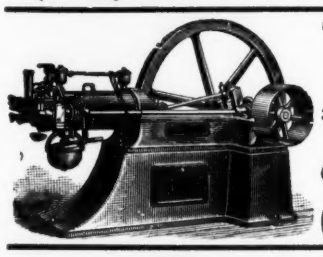

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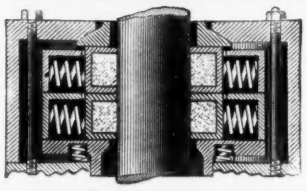

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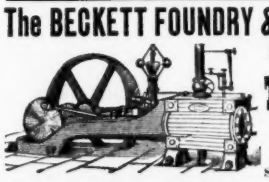

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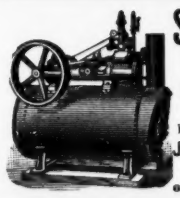

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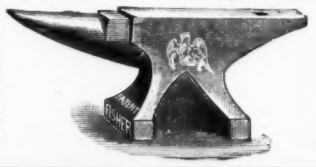

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20 in. x 5 ft.	"	P. & W.,	good.
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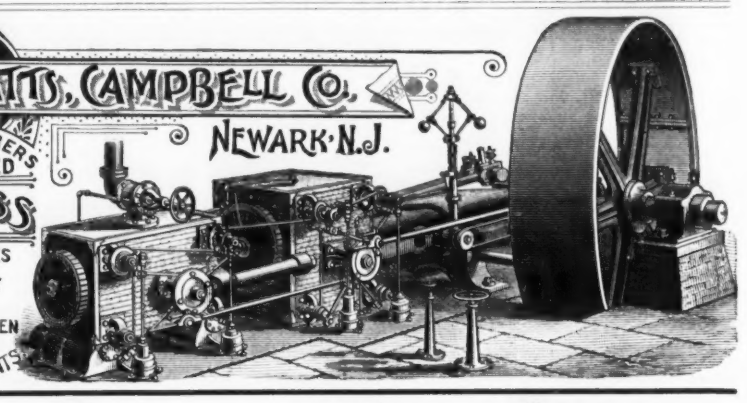

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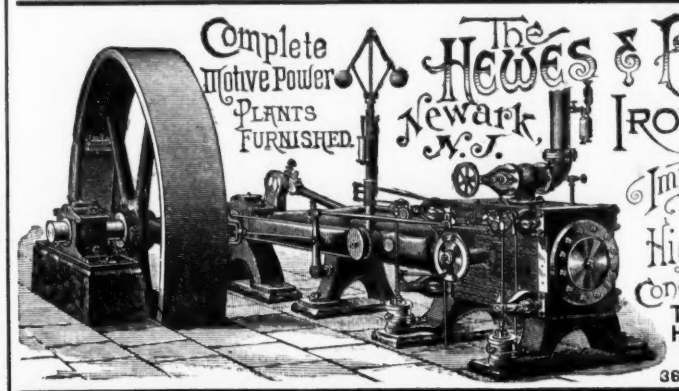

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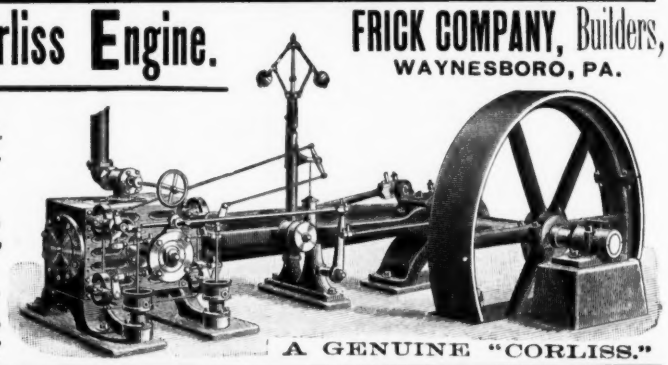

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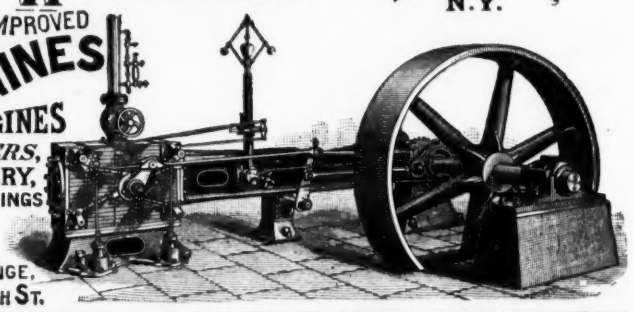

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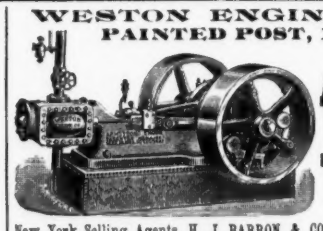

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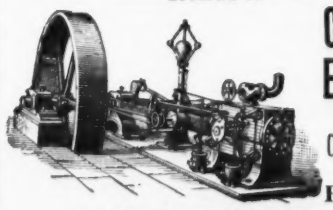

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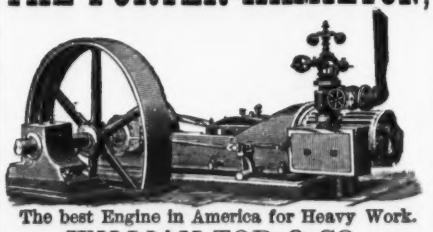

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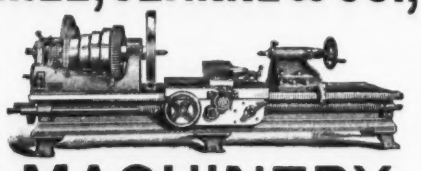

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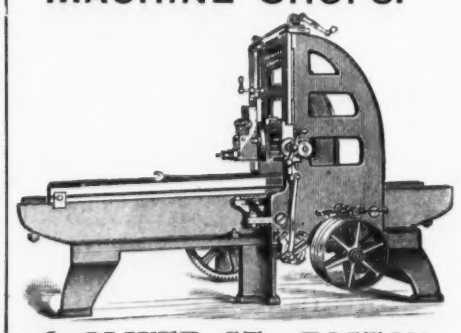

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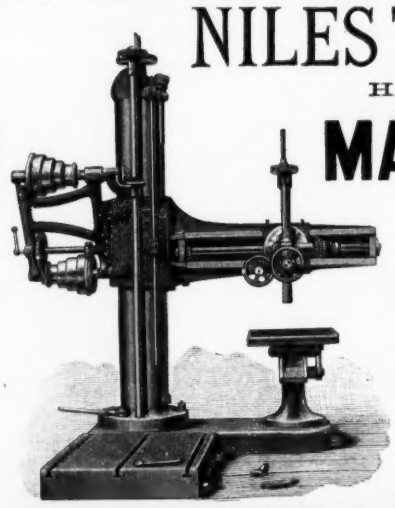
8	1 in.	$\frac{1}{1000}$ in.	E Shaped Frame	4.50
9	25 mm.	$\frac{1}{50}$ mm.	E Shaped Frame	4.50
15	1 in. or 25 mm.	$\frac{1}{1000}$ in. or $\frac{1}{100}$ mm.	Beveled Measuring Points	5.00
16	1 in.	$\frac{1}{10000}$ in.	Beveled Measuring Points	6.00
17	1 in.	$\frac{1}{1000}$ in.	No. 15 with Clamp Screw	5.75
19	1 in.	$\frac{1}{1000}$ in. or $\frac{1}{100}$ mm.	Square Measuring Points	5.50
20	1 in.	$\frac{1}{10000}$ in.	Square Measuring Points	6.50
30	2 in. or 50 mm.	$\frac{1}{1000}$ in. or $\frac{1}{100}$ mm.	Measures from 0 to 2 in. or 0 to 50 mm.	8.00

Catalogues or Illustrated Circulars mailed on application.

NILES TOOL WORKS,
HAMILTON, OHIO.



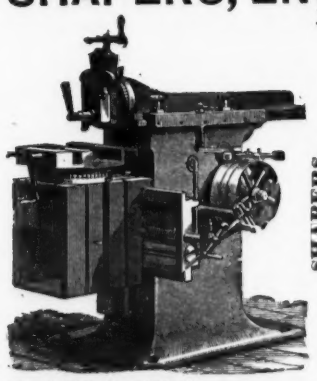
MACHINE TOOLS.
UNIVERSAL
Radial Drilling Machines.
NEW PATTERNS, 1887.
Increased Power. Great Strength. Arm Rotates Freely. Quickly Handled. Drill-Head Balanced.
Patented May 10, 1887.

CRANES
THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA BOSTON

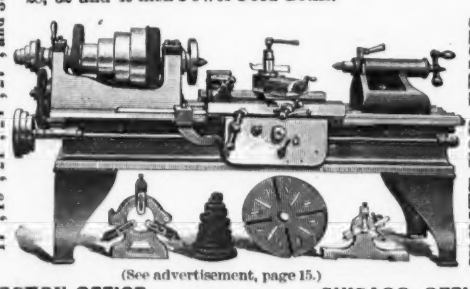
JENKINS BROS. PUMP VALVES.

We make a specialty of Hard Rubber Pump Valves for Hot Water, Oils and Acids, also for very high pressures.
Accept no Pump Valves as JENKINS or JENKINS BROS., unless stamped like cut.
JENKINS BROS.,
71 John St., New York.
54 Dearborn St., Chicago.
105 Milk St., Boston.
21 No. Fifth St., Phila.

SHAPERS, ENGINE LATHES & DRILLS.
LODGE, DAVIS & CO.,
CINCINNATI, OHIO.
20 inch Upright Drills. 25 inch Back Geared, and
22, 32 and 40 inch Power Feed Drills.



SHAPERS, 15" and 20" Crank. 20", 26", 32" Geared.
ENGINE LATHES, 17", 19", 21", 24", 27", and 38".



WRITE FOR PRICES, IT WILL PAY YOU.

(See advertisement, page 15.)

NEW YORK OFFICE, 42 Dey Street.
BOSTON OFFICE, 23 & 25 Purchase St.
CHICAGO OFFICE, Cor. Lake & Canal Sts.

E. GOULD & EBERHARDT,
NEWARK, N. J.
Eberhardt's New Drill
Turns out 20 per cent. more work than any other. APPLY TO

GEAR AND RACK CUTTING TO ORDER.

ANNOUNCEMENT.
CENTENNIAL DAY,
APRIL 30, 1889,
Being a Legal Holiday, our Factory will not be run, but we shall have our Works open for inspection all day. We extend an invitation to our friends, customers and others interested to give us a call on that day, and inspect our plant at our new location,
LAIGHT AND CANAL STS.
E. E. GARVIN & CO.

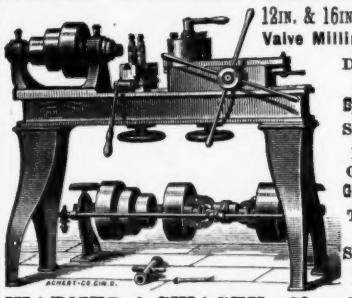
THE PRATT & WHITNEY CO.,
HARTFORD, CONN.,

Manufacture Gardner & Woodbridge patent and new Threading Tool, Rhodes' Square Thread Tool, Woodbridge Lathe and Planer Tool, Johnson's Cutting-off Tool, Kidd's Improved Dividers and Adjustable Caliper Gauges.
WESTERN BRANCH, 100 West Washington Street, Chicago, Ills.

THE BILLINGS AND SPENCER CO., HARTFORD, CT., U. S. A.
MANUFACTURERS OF
BILLINGS' DOUBLE-ACTING
RATCHET DRILL,
For Morse Taper Shank Drills.

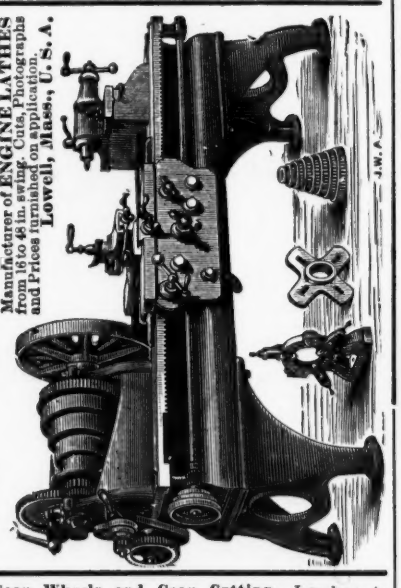
Packer Ratchet Drills,
Packer Boiler Ratchet Drills,
Packer Auger Ratchet Drills,
DROP FORGINGS
OF EVERY DESCRIPTION.

BRASS WORKING MACHINERY.
12in. & 16in. Monitors.
Valve Milling Mach's
Double Key Lathes,
SpeedLathes,
Slide Rests.
Revolving Chucks for Globe Valves
Two-Jawed Chucks,
Small Tools and Fixtures.



WARNER & SWASEY, Cleveland, O.

GEO. W. FIFIELD,
Manufacturer of ENGINE LATHES from 16 to 46 in. swing. Circulars, Photographs and Prices furnished on application.
Lowell, Mass., U. S. A.

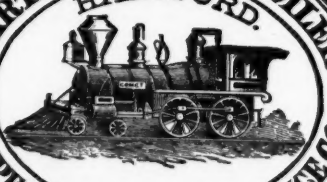


Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat. Geo. B. Grant, 66 Beverly St., Boston, Mass.

Key-Seating Machines and 20 in. Drills
A SPECIALTY.
SEND FOR LIST OF
New and Second-Hand
Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.
W. P. DAVIS,
Rochester, N. Y.
Works at North Bloomfield.

REMOVAL.
THE POND MACHINE TOOL COMPANY,
Formerly of Worcester, Mass.
The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:
A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.
The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.
All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.
SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.
NEW SHOPS, Plainfield, N. J.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.



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F. B. ALLEN, Second Vice-President.
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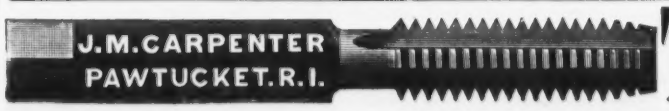
PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND
J. WYKE & CO., TWIST DRILL GAUGE.
Fine Machinists' Tools.—E. Boston, Mass.—Send for Circular

NEW CATALOGUE
MACHINE TOOLS.
THE G. A. GRAY CO.,
477-481 SYCAMORE ST., CINCINNATI, O.
See advertisement, page 13.

STEEL CASTINGS.
PRATT & LETCHWORTH,
PROPRIETORS
BUFFALO STEEL FOUNDRY,
BUFFALO, N. Y.

FOR SALE,
One each 26″ and 36″ second-hand Stevens Pulley Machines. Also one second-hand Buckeye Automatic Engine, Cylinder 6″x10″.
These machines are in first-class order, and will be sold cheap if disposed of soon.

THE HENDEY MACHINE CO.,
TORRINGTON, CONN.

J.M.CARPENTER PAWTUCKET.R.I.

Manufacturer —of— TAPS & DIES